The Design Principles of On-Demand Learning:
A Design-Based Research Study of Educative Provisioning in
Popular Music Production

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Abstract

The formal education of musicians in popular music production requires students to engage with learning to use music technology. This can present a challenge to beginners, who can struggle to engage with the technical processes involved in operating these technologies. Navigating the complexities of a wide range of software and hardware can be a significant challenge. The development of effective strategies for supporting their learning activities requires consideration, because of the volume of information required for successful outcomes.

The delivery of on-demand information through improved access to mobile technologies is a subject of interest in post-secondary education. This learning approach aligns with the learning strategies of users of technologies outside of formal education, where seeking technical tutorials is increasingly more common. Often musicians combine learning opportunities with popular music production activities, because of the wide range of skills and technologies involved in the area. Supporting students with a range of on-demand resources could assist students to develop skills in popular music production.

This research project investigates the design principles that could be used to deliver these resources to maximise student engagement in on-demand learning. The study is conducted using a design-based-research methodology with students and staff within a conservatorium teaching popular music. The cohort of 125 students was invited to participate in the research through surveys and focus groups, while eight staff members contributed to the research through interviews. This evolved a series of design principles, which could be used as a guide for developing on-demand resources to support education in the area.
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Certification

I hereby certify this work is original and has not previously been submitted in whole or part by me or any other person for any qualification or award in any university. I further certify that to the best of my knowledge and belief, this research contains no material previously published or written by another person except where due reference is made in the papers themselves.

Signed: ____________________

Date: 20/06/18
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Introduction to the Research Project

1.1 Contextual Background of the Study

The phrase “popular music production” describes the process of producing popular music, which involves many aspects including recording, programming, mixing, and mastering audio. This process involves the use of a wide range of music technology software and hardware. Music technology has become a subject area that is more commonly found in post-secondary education in recent decades, with formal study options increasingly available (Boehm, 2007). The term music technology often describes the tools involved in electronic music making, although this is at times open to interpretation and dependent on the context in which the term is being used (Boehm, 2007). Training students in the field of popular music production invariably involves developing student understanding of music technology operation and application. Acquiring skills in operating these music technologies can take many years, and historically audio engineers developed their skills by assisting in recording studios (Slater, 2016). Technological advancement has also had an impact on these developments. The pervasive spread of digital music technologies has changed the demographic of music technology users (A. Bell, 2014; Draper, 2008; Théberge, 2012). The contemporary environment has seen music producers working in smaller recording studios because of the widespread availability of digital music technologies. These technologies have opened up the field to non-specialist audio engineers, who are often musicians producing their own work.

Ten years ago, I was appointed to the role of recording studio technician within a conservatorium delivering a popular music program. At the time of writing this thesis, I am still in this role. The student cohort with whom I work, generally fall into this non-specialist audio engineer category. They often use music technology as tool for writing music. Many
of them don’t see themselves as audio engineers, but more as musicians using music
technology as part of their working process. Working with and understanding aspects of
music technology can be particularly challenging to some of them. This is because of the
breadth of knowledge they are required to develop in a relatively short time frame. The use
of music technology is often new to them when entering the program, involving
development of a wide range of skills and knowledge, as well as specific knowledge of the
environments that they work within.

Through this role, I have also observed the frustration of students coming to terms
with making these music technologies work effectively. My experience has taught me that
often the source of their technical issues lies in their lack of specific operational experience
of these technologies. Students learning to operate music technology often require additional
support, and providing this can improve their outcomes (King, 2009). Supplementary
learning opportunities that scaffold music technology skills have a role to play in facilitating
learning (King, 2008). The impact of having limited music technology skills can affect the
outcome of their work in a number of ways. Some students lack basic skills, which causes
them to experience technical issues while using music technology; others lack a deeper
knowledge of these technical skills, which inhibits their ability to engage with using music
technology to its full potential. There is also the issue of having a thorough understanding of
the theoretical knowledge related to music technology equipment. Understanding how and
why the technology works is also necessary for positive outcomes.

There are multiple factors that can lead to the development of these issues. The first
factor the design of coursework involving music technology. A focus on working in groups
provides authentic context for students, however in these structured learning activities there
are many music technology skills that individual students do not get to engage with. Music
technology classes often involve working within groups, with some students taking on the
role of musician, while others take on the roles of audio engineer or assistant engineer (King,
2008). Some coursework within the Bachelor of Popular Music focuses on capturing live
performance, as a means of emulating particular recording styles (Anthony, 2015). During
these classes students also take on a variety of roles. The students playing the role of musician in these classes often do not engage with operating music technology during class. These students leave the operation of the technology to those fulfilling the role of producer or engineer, which leads to missing opportunities to learn to operate the technology in a supported environment.

Another factor is the multifaceted nature of recording studio environments used in popular music production. Recording studios involve the integration of multiple pieces of equipment to record music. This often involves developing an intricate working knowledge of these environments. If students miss opportunities to engage with operating equipment throughout the program, they can miss vital pieces of information necessary to function in these spaces effectively.

The evolutionary nature of music technology is also a factor. Maintaining current working knowledge of some music technology tools can be challenging, because of advancements to a range of music technology software and hardware. Keeping up with emerging music technology tools and popular music production techniques can be challenging, even for professionals. My role within the popular music program has involved supporting these students with using music technology, as they often seek my assistance when they experience technical problems. This has led to me recognising the need to provide learning support for these students to scaffold their technical abilities and influence their popular music production outcomes.

In order to address the issues described above, the following study’s focus was to develop design principles to provision on-demand resource support for these students. On-demand learning opportunities are becoming increasingly relevant in today’s society (Tozman, 2012). Access to informal learning opportunities that are “just enough, just for me, and just in time” (Brandenburg & Ellinger, 2003, p. 308) has been employed in workplaces to support training needs. The rapid expansion of learning opportunities fuelled by mobile technologies is enabling on-demand learning to become part of everyday life (Hartley, 2000; Tozman, 2002). On-demand learning offers self-directed learning opportunities that fit into
busy lives, allowing learners to engage with topics as they become relevant to their immediate needs (Hartley, 2000; Taminiau et al., 2015). This has potential implications for training in the area of popular music production, where on-demand learning could offer viable solutions to support education in the use of music technology. Supporting students with on-demand resources could be an effective means of providing technical training in a way that delivers relevant information at the right time for these students.

The popular music students involved in this study were enrolled in the Queensland Conservatorium’s Bachelor of Popular Music (BPM) program. This program, offered at Griffith University’s Gold Coast campus, allows students the opportunity to develop skills in popular music production to assist in their creative process as working musicians (Lebler, 2007; Lebler & Weston, 2015). The BPM program has operated in this facility since 1999, and has an intake on average of 55 students annually. The students enrolled in this program come from a wide variety of backgrounds. Within the program you will find a mix of songwriters, drummers, guitarists, electronic music producers and vocalists. Often these students have multiple talents, but the focus of the program is predominantly on performing popular musicians. Central to this learning experience is the provision of access to recording studios and audio post-production facilities where students write, record, edit, and mix original music. Music technology has a pivotal role to play in the delivery of this program, with a wide range of recording technologies in use throughout the recording studios, with students engaged in popular music production to facilitate their musical development. The technologies include a range of digital audio workstation (DAW) recording software and plug-ins, with Pro-Tools as the fundamental software used to facilitate recording. There is also a wide range of audio hardware available to students, including pre-amplifiers, compressors, microphones, and mixing desks used within the recording studios.

The program is pedagogically underscored by employing the informal learning approaches often used by popular musicians outside of the formal education environment (Green, 2001; Lebler, 2008). Green (2001) recognised that while popular musicians had been previously excluded from formal music education, they were generally intrinsically
THE DESIGN PRINCIPLES OF ON-DEMAND LEARNING: A DESIGN-BASED RESEARCH STUDY OF EDUCATIVE PROVISIONING IN POPULAR MUSIC PRODUCTION motivated to learn their craft. Harnessing this tendency to learn informally forms the pedagogical foundation to how the BPM program is structured, particularly within the courses involving popular music production. This pedagogical approach in the area of popular music education is not unique. Examples of similar approaches at other institutions occur around the world (Feichas, 2010; Folkstead, 2006; Green, 2001; Jaffurs, 2004). Students within the program participate in a “self-directed learning community” (p. 205) where students engage with learning related to their own interests and internal motivations (Lebler, 2007). The BPM program has been the subject of previous research surrounding the aspects of informal learning facilitated through popular music production (Lebler, 2007, 2008; Lebler & Hodges, 2016). The program is focused on the development of popular musicians and songwriters, with a strong connection to the use of the recording studio within the program’s major study. The major study stream involves students submitting a folio of original self-recorded works for assessment. The supporting suite of courses in sound principles, audio engineering, and music production all revolve around the operation of the recording studio (Lebler, 2008). The students work across a range of genres within the area of popular music. Popular music in itself is hard to define, as the boundaries between musical style and popularity are often ambiguous (Shuker, 2002). These students often work within a range of generic popular music genres, including country, rock, pop, metal, folk, indie and electronic. There is nothing that identifies them as unique to their Australian heritage in their popular music production activities.

The role of the recording studio in the BPM program is to develop self-directed and critical listening skills related to song writing and music production. All students involved in the program use the recording studio with varied proficiency. Some engage with the technical aspects of using a recording studio more naturally than others. The recording studio plays a pivotal role in popular music production. Therefore, maintaining and developing a solid working knowledge of how to use music technology is important to the success of these students (Lebler, 2007). A conventional recording studio involves the interaction of a
range of music technology software and hardware devices. Within the BPM studios there is a large array of music technology equipment working together.

While developing a working knowledge of these environments is challenging for BPM students, maintaining their knowledge of music technology is relevant to their needs as graduates. Even in the relatively short time that the program has been offered, the area of music technology has undergone extensive technological advancement. In the early days of the program, students recorded audio to multi-track digital tape, until the proliferation of digital audio workstation technologies. These DAW technologies also interact with a wide range of music technology hardware within the recording studio, often involving patching signal cables between several pieces of equipment to complete a signal chain.

Outside of formal education environments many musicians engage with learning through online channels to develop skills and problem solve (Kruse & Veblen, 2012; Salavuo, 2006, 2008; Waldron, 2009, 2012, 2013, 2016, 2018). Maintaining a working knowledge of these music technologies sometimes involves independent research (due to the large range of music technologies available). This is a skill that music production graduates will need to develop in order to maintain a working knowledge of music technology. DAWs are the subject of constant revision by software developers. Audio editing and processing features are refined with each software release. In addition to this, music technology hardware is also constantly changing, with new music technology tools being released regularly. Based on the changing nature of the software, updates require strong self-directed learning skills. Each release of DAW software or music technology hardware can involve independent research by both staff and students to become familiar with developing operating procedures. Supporting student users of music technology through these environments has the potential to develop their skills in self-directed learning and popular music production.

Given the aforementioned, it can be understood that students from all stages of the program may struggle to develop the technical skills required for successful operation of these music technologies. This is often a constant source of frustration to these students, who
encounter a steep learning curve, particularly evident in the early stages of the program of study. BPM students typically work in the studio unsupervised to complete portfolio recordings in a “scaffolded, self-directed learning environment” (Lebler, 2008, p. 193). It is during these unsupervised studio sessions that some students can face technical difficulties with little direct support available, or specific knowledge to draw upon. This has seen an increasing reliance on peer networks working within the facility or through social media to solve their technical problems as they arise. While peer learning is beneficial to student learning, technical difficulties are disruptive to the creative process. Disruptions can mean that songwriting and music production outcomes have to be put aside until the technical difficulty is solved. These difficulties can also lead to poor music production outcomes, through uninformed decisions related to the use of music technology.

Apart from the knowledge of individual pieces of music technology equipment like DAW software and audio hardware, successful operation of a recording studio requires the development of fundamental knowledge surrounding a range of music technology concepts because of the large range of music technology equipment involved in a recording studio set-up. These music technology concepts fall broadly into four categories:

1. Theoretical conceptual knowledge
2. Operational knowledge of studio specific hardware
3. Operational studio specific software knowledge
4. General audio software knowledge

Firstly, a solid working knowledge of theoretical concepts including audio frequency, equalisation, dynamics processing, digital audio theory, gain structure, dynamic range, and microphone theory provides a fundamental theoretical framework for operating a recording studio. In the area of music technology education it has been suggested that the interdisciplinary nature of these theoretical concepts is problematic for some students (Ferreira, 2007). Working with these theoretical concepts requires students to engage with digital audio theory, physics, and audio-engineering principles as the fundamental knowledge required to produce music. Without understanding of these concepts popular
music production outcomes can be affected. Providing access to on-demand information could assist with assisting students to become more familiar with the theoretical concepts, through providing resources that provide context to their popular music production activities.

Secondly, specific knowledge of the operational features of audio hardware equipment used within the recording studios is also necessary for successful outcomes. This involves developing a working knowledge of relevant equipment found within the space including, control surfaces, audio patch-bays, microphone pre-amplifiers, audio compressors, audio effects, microphones, headphone distribution systems, and audio monitoring set-up. This form of knowledge also requires information about the interaction between these pieces of hardware, a topic that is often specific to the recording studio’s configuration. King (2007) discusses the need for students to be able to operate in the context of the Queensland Conservatorium studio facility, students’ lack of fundamental knowledge can be complicated further by the idiosyncratic nature of some recording studio set-ups, which become more complex as the students move through the program. While there is a degree of consistency within the recording studio set-ups used in the Queensland Conservatorium, there are differences between the individual studios used during the various stages of the program. Moving between unfamiliar environments can serve as a source of technical difficulties, through lack of specific knowledge related to the studio space. Advancing through the three years of the undergraduate program, these students are granted access to studio spaces with incremental degrees of complexity, because of the need to build skill development in recording studio operation based on the curriculum taught to the various year levels by academic staff. While the problem is magnified when students enter the program due to a lack of general knowledge, issues with learning to use these music technologies can also apply across the degree program.

Thirdly, background knowledge of studio-specific audio software set-up is also highly relevant to operating the studio successfully. This knowledge includes background knowledge of system configuration including connecting audio input devices to software, input/output set-ups, playback engine settings, and other recording settings that maximise
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system efficiency. Without specific knowledge of these aspects of the recording studio set-up configuration, students can experience difficulties with operating the recording studio.

Finally, general knowledge related to DAW operation including audio editing, signal flow, mixer configuration, plug-in configuration, and a range of other audio processing options is also highly relevant to operating a recording studio effectively. This information enables the features of DAW software to be utilised to its full potential. Thorough understanding of the DAW has the potential to improve outcomes through more effective use of the production tool. The education of fundamental knowledge across these four areas allows students a sufficient breadth of knowledge to use a recording studio.

The BPM program of study has incorporated pathways that afford some students the opportunity to focus on the development of performance and song writing skills, while others focus on the area of music production. Though not all graduates will end up working as music producers, the ability to produce and engineer their own work is a highly valuable skill for any musician. The ethos of the BPM program encourages students to develop skills in this area for this reason (Lebler & Weston, 2015). Once students graduate they work within an industry where the ability to engineer and produce their own recordings is advantageous. This is because of the increasing affordability of music technology equipment and the benefits associated with working from a home studio environment (A. Bell, 2014). It could be argued that there are benefits to improving student abilities in this area across the degree program since the development of self-directed learning skills is valuable for these students in preparation for their work in a highly competitive industry.

Throughout the program these students work within recording studio environments that increase in complexity. This culminates in the third year of the program, when students are given access to a recording studio that involves engaging with a mixing console that integrates digital and analogue mixing practices. With a range of new equipment and working methods to learn, offering these students the opportunity to develop their skills in self-directed learning prepares them for working with music technology after graduation. The ability to adapt and use these technological tools once they leave the conservatorium

...
environment will prepare them with the lifelong learning skills needed to thrive in this industry.

Some studies have previously investigated the potential for supporting the learning of music technology through technology, while supporting problem solving in the recording studio (King, 2009b; King & Vickers, 2007; Voss, 2016). There are other factors that suggest that delivering training in this way could be useful and engaging for these students. Users of music technology working in recording studio environments often engage with learning skills as required by their creative process (Slater, 2016). Learning is part of the normal working process of those who engage with using music technology, due to the exploratory nature of the process. Outside of formal education the music technology industry is engaged with online learning to support its clients (Avid, 2017; Gearslutz, 2017; Pro-Tools Expert, 2017). The prevalence of this approach to learning in the industry suggests that supporting BPM students with on-demand resources could have many benefits including the potential to develop their self-directed learning of music technology skills.

The rapid development of technology has also impacted considerably on the development of the music industry and on the ways that musicians engage in creating and sharing their work. The use of the recording studio and development of skills in this area has become a core practice for many musicians. This is because of the increasing availability of affordable recording technologies, where in the past audio engineering was a specialised field (King, 2016). Musicians in today’s industry often work in their own home studios, combining the role of engineer and musician, which involves learning technology and production skills as a part of the music creation process (Slater, 2016). Skill development is enabled through access to Internet online tutorials on broad ranges of topics and equipment. Developers and users of music technology participate freely in an exchange of information supporting skill development and problem solving (Gearslutz, 2017; Pro-Tools-Expert, 2017; YouTube, 2017). Waldron (2018) suggests that there is a conflict between music education, and the opportunities for music learning offered through social networking and media sites. This has come about because of disagreement about the authenticity of “21st
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century practices” because of the discrimination against digital music making (Waldron, 2018, p. 97). Provision of additional on-demand resource support within post-secondary education aligns delivery with the multi-layered peer network available through on-line music learning opportunities.

The sharing of technical information to inform users of music technology has rapidly escalated in recent years (Webster, 2011). For example, there are many channels available via YouTube (2017) where individuals and organisations share their expertise in the use of music technology. YouTube (2017) is also a recognised hub for on-line music learning, with multiple communities of practice facilitated through this web site (Cayari, 2011, 2015; Tobias, 2012, 2015; Waldron; 2012, 2013a, 2013b, 2016, 2018). Music Technology tutorials found on YouTube (2017) often cover the use of software and hardware, and involve sharing specific techniques related to these technologies. Developers in the area also participate in these environments through the provision of tutorials related to hardware and software operation. As another example, Universal Audio (2017) provides tutorial information which is integrated into the support section on their website. Avid (2017) also provides similar services through their web pages.

Music technology users also engage in the exchange of information through online forums where technical issues related to these technologies are discussed. A prominent example of this is the web page Gearslutz (2017), which incorporates forums, reviews, and equipment databases to service the users of music technologies. While these types of information exchange communities proliferate around the music technology area, other examples are common in other aspects of music education, which support learning in the area (Jorgensen, 2014; Kruse, Harlos, Callahan, & Herring, 2013; Kruse & Veblen, 2012; Waldron, 2011). While these resources can also benefit students, there are many aspects of recording studio set-ups that are specific to individual studio spaces. Often what cannot be found through an online search is how aspects of music technology hardware and software interact together in these spaces. Providing on-demand resources can provide this form of
support through delivery of contextualised information relevant to the way music technology is configured within a recording studio.

Education technology forecasts suggest that technology is changing the face of post-secondary education, which as a result is experiencing a rapid change in focus, including the spread of mobile technologies (Adams Becker et al., 2017). Access to information through the spread of technology has witnessed the emergence of a knowledge society (Wessels, Finn, Wadhwa & Scveinsdottir, 2017). Because of the availability of information, the role of universities is changing from curators of knowledge to that of designers of knowledge systems (Boehm, 2018; Laurillard, 2002; Ricaurte, 2016). Adams Becker et al. (2017) in The New Media Consortium Horizon Report- 2017 Higher Education Edition propose that “online, mobile, and blended learning are foregone conclusions. If institutions do not already have robust strategies for integrating these now pervasive approaches, then they simply will not survive” (p. 2). Incorporating on-demand learning into the delivery of post-secondary education is an area of constant development and a major priority for many institutions (Johnson, Becker, Cummins, & Estrada, 2014). This demand has been driven by the extensive access to information available through these technologies, which has delivered widespread opportunities for the general public to access information on demand (Tozman, 2012).

Personal technology use has also impacted on expectation for post-secondary education delivery. With the current availability of information through mobile technologies and access to the World Wide Web, researching and accessing information on demand has become a part of everyday life (Hartley, 2000). The rapid pace of change that these learning environments are setting outside of post-secondary education is also having a major impact on how learners expect to be educated in formal environments (Tozman, 2012). Central to this evolution is the need to increase the integration of informal learning opportunities through the use of online, blended, and mobile technologies to support traditional coursework (NMC, 2017). The educational potential of these technologies has been recognised as significantly important to the post-secondary education sector.
education institutions commonly engage with on-line learning to some degree, though often the level of engagement is up to individual course convenors to decide. In some areas this works well, where lecture content is offered on-line and in person, supported by relevant electronic resources. Facilitating student engagement with accessing information on demand is highly relevant to post-secondary education because of these developments.

The development of social media has also impacted on student expectations of learning in post-secondary education. Education researchers have already recognised that many students use these tools to search out information and build networks to support their personalised learning journey (Mundie & Hooper, 2014). The use of pedagogical initiatives to develop the integration of these technologies is an area of constant development (Adams Becker et al., 2017), driven by the nature of how students engage with the information facilitated through access to these widespread information networks. Many post-secondary education institutions are integrating social media to augment their learning strategies (Selwyn, 2012). Student engagement with using Facebook (https://www.facebook.com) to build networks, exchange information, and research their interests is pervasive in the current post-secondary education environment. These student patterns of information exchange are building to a point where transmission-styled approaches to delivering content are rapidly losing relevance.

The Internet has also been recognised as an important tool for formal music education, having considerable potential for educating musicians. However, there is often a disparity between how musicians engage with the Internet technologies and how institutions structure learning (Draper, 2008). Draper (2008) recognised that the structured learning environments offered by universities do not reflect the dynamic environment available to musicians outside of the institution. His argument is that creative arts educators need to consider the potential of “dynamic ontologies that can be maintained in a training environment reminiscent of social networking” (p. 137). Many students arrive at university with laptops, while others simply arrive with their mobile phones. These mobile technologies have great potential to inform, educate, and transfer relevant information on demand to assist these users to make
connections with the technological tools they use in their work. This thesis will contribute to popular music education by developing a set of design principles for the delivery of on-demand resources to support the use of music technology.

1.2 Purpose of the Study

The purpose of this study is to identify the design principles of on-demand learning for educative provisioning in popular music production. It will address this through asking the overarching research question

What design principles should be employed in delivering on-demand resources to support students learning popular music production?

This research question is supported by three sub-questions that investigate different aspects of the research question:

1. In what ways can on-demand resources be delivered to students learning skills in popular music production?
2. In what ways are on-demand resources being utilised by students learning popular music production?
3. In what ways can on-demand resources be structured to deliver instruction in popular music production?

There are other purposes that also motivate the study. Through identifying the design principles for on-demand learning resources, more effective learning resources should evolve. This has the potential to improve student-learning outcomes. Providing access to a range of relevant on-demand resources could potentially affect student-learning outcomes related to recording studio operation and music technology concepts. These outcomes could include less down time due to technical issues with recording equipment, better recording outcomes for student portfolio recordings, improved knowledge retention in relation to music technology equipment operation, and improved self-directed learning skills in relation to music technology.

Another motivation for the study is expanding the range of learning opportunities
available for students. Currently there are limited opportunities for students to engage in on-demand learning of specific music technologies through the school. Opportunities for learning through these channels are plentiful outside of formal education (Gearslutz [https://gearslutz.com]; Universal Audio [https://uaudio.com]); however, it is also the case that beginners have limited understanding of where to go for correct, relevant information. Apart from the complexities of finding this information, the use of the recording studios often relies on specific, contextual information that relates to the studio space and equipment configuration. Examples of this would be the way the control surface handles audio monitoring, and how various pieces of hardware equipment work together to deliver a functional studio.

Another purpose for the study is developing the self-directed learning skills of the cohort. Provision of on demand learning opportunities may better prepare these students for learning after study through scaffolding them with the development of self-directed learning skills.

1.3 Thesis Structure

This thesis is arranged in seven chapters. These chapters include:

- Chapter 1- Introduction to the Research Project
- Chapter 2- Literature Review
- Chapter 3- Methodology and Research Method
- Chapter 4- Initial research: A Pilot Study
- Chapter 5- On-demand Resource Development: Design and Testing
- Chapter 6- BPM Studios Mobile Phone Application
- Chapter 7- Conclusions and Design Principles

This, the first chapter provides an overview and introduction to the study. It then addresses the contextual background and purpose of the study.

Chapter 2 outlines the literature reviewed for the study. Initially the literature review covers popular music education and what constitutes education in this discipline. The
relationship between music, technology, and education is highlighted before investigating literature that discusses the continued influence that technology is having on post-secondary education more broadly. Finally, the literature review outlines a set of established design principles for mobile delivery to inform elements of the on-demand resource design principles.

Chapter 3 discusses the methodology and research methods used during the study. It details the processes involved in facilitating the design-based research project. The chapter then identifies the research methods employed during the three iterations of the research project.

Chapter 4 reports the pilot study, which was conducted to establish the initial design principles developed from the study. It presents the various delivery methods and content developed during the study and shared with students as a part of the research. It also seeks to establish student interest and engagement with these types of delivery methods in the area of popular music and music technology education. This chapter introduces an academic staff perspective on the topic of on-demand learning. It details interviews conducted with BPM academic staff regarding topics such as the role of on-demand learning, context, and the development of effective design principles. It reveals how the BPM academic staff members perceive the BPM student cohort, the role of self-directed and peer-assisted learning within the program, and their implications for design principles of these resources. This chapter concludes with the BPM academic staff members’ perspective on appropriate design principles for sharing on-demand learning resources.

Chapter 5 discusses the development of the mobile phone application -- BPM Studios. The application was created to bring all aspects of the pilot study research together in one package. It presents student focus group data and focus group feedback on the initial design of the application before its release to the general student cohort.

Chapter 6 examines the rollout of the BPM Studios mobile phone application to the general student cohort within the BPM program. It presents student feedback on the application, as well as ideas for design improvements and modification. It also investigates
how students view their engagement with this learning tool and the ways in which engagement was facilitated by the application.

Chapter 7 is a summary of the study. The chapter presents an overview of the research and its’ positioning based on the surrounding literature, and delivers the design principles developed through the research project together with recommendations for future study.
2

Literature Review

2.1 Overview

Chapter 2 presents the literature that informed the research project, through investigating the area of popular music education, music technology, and on-demand learning. It demonstrates the synergy between these areas, which progresses the argument that on-demand resources should be incorporated to support education in popular music production. The literature review initially investigates popular music education, establishing the growth of the formal study of popular music throughout post-secondary education (Cloonan & Hulstedt, 2012). What constitutes popular music education is presented, as well as an outline of the pedagogical approaches employed by educators in this discipline (Carfoot, Millard, Bennett, & Allan, 2016; Lebler, 2008). The discussion highlights the underpinnings of some providers of popular music education and their alignment with self-directed learning principles before theorising the incorporation of on-demand learning opportunities within the BPM.

The literature review then explores the developing relationship between post-secondary education and formal education in the area of music technology (Boehm, 2007). The research reveals how education providers need to formulate new pedagogical paradigms to support this evolving area, providing a rationale for this research (Davis, Parker, & Thompson, 2014; King, 2016). This demonstrates that music technology education has an inherent need to develop effective strategies for facilitating learning. One of the factors influencing this is the diverse nature of the subject, which requires students to negotiate unfamiliar topics outside of their discipline area (Ferreira, 2007). There is also a recognised need for education in this area to be informed by research, which investigates the balance between theoretical and vocational practice to develop more effective pedagogies (Zagorski-
The next section examines trends in music education, which suggest that educative provisioning through on-demand resources could be effective. Outside of formal teaching environments, learning in the broader music community has been facilitated through on-line learning opportunities (Draper, 2008; Pro-Tools-Expert, 2017; Waldron, 2018). The act of learning through on-line tutorials is widespread in the area of music generally, which has embraced learning facilitated by access to these environments (Cayari, 2011, 2015, Kruse et al., 2013; Kruse & Veblen, 2012; Waldron, 2009, 2011, 2013a, 2013b, 2016, 2018).

Following this, literature that reinforces the need for supporting music technology education through learning resources is discussed (King, 2008, 2009a, 2009b). These studies highlight the need for resources to support the use of music technology within the context of post secondary education. This is examined alongside research into the learning process of musicians. Slater (2016) proposed that on-demand learning is frequently embedded into the workflow of musicians. That is that musicians learn to operate new technologies as required by their project. These aspects of the literature review begin to develop the idea that the incorporation of on-demand learning opportunities could potentially benefit formal education in music technology.

The literature review then offers a summary of the continued influence that technology is having on post-secondary education. A recurring theme throughout this literature is the need for formal education providers to keep pace with technology usage patterns outside of education (Tozman, 2012). Outside of post-secondary education access to vast stores of information has led to the development of a knowledge society (Wessels, Finn, Wadhwa & Scveinsdottir, 2017). This has meant that post-secondary education providers are no longer curators of knowledge, which has implications for the design of learning experiences (Boehm, 2016; Laurillard, 2002; Ricaurte, 2016). The development of a knowledge society has meant that delivery strategies including on-demand learning (Tozman, 2012), mobile learning (Mundie & Hooper, 2014), and just-in-time learning (Brandenburg & Ellinger, 2003) are rapidly becoming a mainstream consideration,
facilitated through the increased availability of information technologies (Adams Becker et al., 2017). Support for the incorporation of on-demand delivery strategies into curriculum design becomes evident because of their widespread impact outside of formal education. The increasing presence of information technology has delivered a climate where client expectations of learning environments have fundamentally changed (Kukulska-Hulme, 2012). Through the development of on-demand learning resources, the opportunity for just-in-time, contextualised learning supporting these students can be realised.

Some research suggests that there are often assumptions surrounding the perceived technical abilities of students (Bennett & Maton, 2010; Margaryan, Littlejohn, & Vojt, 2011; Prensky, 2001). Bennett (2012) suggests that while it is claimed that those born in the digital age have inherent skills in using technology, there is often a variety of ability levels within this demographic. The research conducted by Bennett (2012) supports the idea that students learning popular music production have varying levels of technical ability, reinforcing the need for incorporation of on-demand learning resources. It also suggests that while students do exhibit a preference for using technology tools for learning, they may require learner scaffolding (Thompson, 2013). This has implications for the design of on-demand supporting resources. Which may suggest that music technology coursework needs to offer explicit instruction on the use of these supporting resources.

The literature review will then report the design principles proposed by educational designers in the area of mobile learning are also highlighted (Gu, Gu, & Laffey, 2011; Lecheler & Hosack, 2014). Integral connections for mobile learning design and applications are considered. Mobile learning design is an established field of study that offers considerations for the outcomes of this research. Researchers in this area have recognised that mobile learning designers need to “meet their learning needs to solve problems or satisfy curiosities” (Gu et al., 2011, p. 213). These considerations will be drawn upon to inform the mobile application design principles evolving as an outcome of this research.

The impact of social media on student expectations of on-line learning environments is then discussed (Rowan-Kenyon et al., 2016). The high level of engagement with social
media platforms has the potential to inform the design principles for on-demand learning resources. This is largely due to the design of social media environments’ continuing to influence student expectations of information exchange (Cooke, 2017). These developments suggest that social media has the potential to inform the development of design principles for on-demand learning resources.

2.2 Popular Music Education

The formal education of popular musicians is becoming more common within post-secondary education. This trend has been motivated by cultural demands and economic factors, and it has developed despite resistance from traditional conservatorium education practice (Lines, 2005). In the past, a cultural divide was exemplified in the exclusion of popular music from the traditional music education curriculum (Lines, 2005). Traditional forms of music education relied on “strictly controlled pedagogical systems and ordered curricula” to deliver content to students (Lines, 2005, p. 2). Lines (2005) also argued that a cultural divide tended to dominate music education through the exclusion of popular music, which denied its “value and existence” (p. 2). However, there has been significant growth in the area of popular music education over the past 15 years. Cloonan and Hulstedt (2012) researched offerings across the UK, finding that popular music studies had in most cases been introduced in the previous 10 years. They identified that popular music studies can include a number of areas including “Popular Music, Commercial Music, Music Industry/Business, Music Management, and Popular Music Performance/Production” (p. 4).

Defining what is meant by the study of popular music education is still in a developmental state. Weston (2017) recognises that popular music education is evolving from a combination of the areas of popular music studies and popular music practice: Popular music studies in some contexts refers to the study of the social-cultural aspects of popular music education while popular music practice often focuses on the vocational aspects of popular music. Popular music education involves students engaging with producing music and this itself is also an emerging field of research (Anthony, 2015).
In their review of popular music education in America, Powell, Krikun, and Pignato (2015) proposed that while popular music education is expanding, it has struggled for acceptance. This is further exemplified across various institutions, teaching contexts and respective music degree components. Carfoot et al. (2016) found that there were many different approaches to delivering popular music education across tertiary environments in Australia. This was also the opinion of Cloonan and Hulstedt (2012) who felt that popular music education could be delivered in a variety of ways. They stated “such diversity of titles means that it is very hard to define ‘core’ elements of Popular Music Studies degrees” (p. 4).

Popular music education includes informal, self-directed learning opportunities, to align with the needs and preferences of the student as a basis to pedagogical design (Folkstead, 2006; Karlsen, 2010; Lebler, 2008). Through emphasising self-directed learning, educators give students the opportunity for more autonomy and the ability to make more choices (Feichas, 2010). This pedagogical stance developed through recognition of the learning approach of popular musicians outside of formal education. Although popular music was traditionally excluded from music education, practitioners of popular music developed their own informal approach to learning their craft; Green (2001) recognised that this has implications for music education, through harnessing the instinctive learning displayed by musicians. These learning approaches were used to structure popular music education and have been the subject of previous research (Folkstead, 2006; Green, 2007; Lebler, 2007, 2008). Since Green (2001) conducted this study, on-line environments have also enhanced the depth of informal learning practices because of the potential of these spaces to connect musicians (Waldron, 2016). These interconnected spaces have facilitated what Waldron (2017) refers to as “informal music learning practices 2.0” (p. 3). The spread of these environments has a distinct potential to inform music education, through acknowledging music making outside of formal education environments (Waldron, 2016).

The Bachelor of Popular Music program, which is the focus of this research, uses informal learning to facilitate learning through authentic contexts (Lebler, 2007). This program fosters innovative pedagogical approaches “based on the creation of a scaffolded
self directed learning community” (Lebler, 2007, p. 205). The major study stream of the program Popular Music Production facilitates student learning through producing music (Lebler, 2007). During this process student learning is scaffolded through reflecting on and critiquing their own and each other’s work.

The act of producing music builds a range of broader skills that develop as a result of engaging in this process. Such an approach to facilitating learning is also aligned with preparing musicians for the skills needed in the contemporary industry. Carey, Draper, Lebler, and McWilliam (2006) argue that the traditional “master-apprentice” teaching model employed by conservatoria is out-dated and needs to focus on giving students the skills to “un-learn” as well as learn new techniques and approaches (p. 25). Lebler (2008) also recognised this need for change in music pedagogy in a separate study. Lebler stated “as society becomes more complex and information-rich, people need to constantly re-think, be adaptable, and develop new problem-solving strategies for new challenges” (p. 194). This suggests that popular music education also needs to adapt and change with the evolving landscape of the contemporary music industry (Lebler & Weston, 2015). Without a paradigm shift, popular music education is at risk of becoming irrelevant to musicians’ needs.

These ideas a synergistic with on-demand learning through alignment with the self-directed nature of the style of popular music education employed within the BPM program as described by Lebler (2008). The focus of this program is aligned with real-world, informal, structured learning opportunities (Anthony, 2015; Lebler & Weston, 2015) that are informed by the ways that popular musicians outside of these environments manage their learning (Green, 2001). The on-demand model for education allows students more control of their learning through increased flexibility and choice (Tozman, 2012). In this way, delivering enhanced flexibility in learning approaches can be appropriately accessed and supported.

2.3 Music Technology and Post-Secondary Education

Music technology enables popular music production: Without music technology,
popular music production would not be possible because it provides the tools required to engage in the process. However, the nature of music technology’s constant change presents challenges in the development of pedagogical models.

Music technology has been broadly defined as electronic technologies commonly used in making music (Boehm, 2007). Music technology refers to sound recording equipment, synthesizers, computers, DAW software, and associated equipment involved in popular music production (Brown, 2007). These tools work together to form a recording studio.

Increasingly, music technology education is formally taught by post-secondary education (Boehm, 2007; Lebler & Weston, 2015). Delivering music technology coursework in post-secondary education is a growing area, this has been fuelled by the increased availability and affordability of recording software. Programs offering education in the area of music technology are now becoming a recognised part of the music education field (Boehm, 2005; Draper, 2008; Slater, 2016). Boehm (2007) highlights an emerging synergy, through tracing the increasing activity of music technology graduates in education, with formal training becoming increasingly common.

Pedagogical approaches used for teaching skills in music technology are still developing. Boehm (2007) offers a commentary on the developments and challenges faced by music technology as a subject area in higher education overall. The relative infancy of the field has meant that existing models are lacking and pedagogical approaches are being continually developed and refined (Boehm, 2007). Serra (2005) also recognises this, and identifies music technology as an interdisciplinary field that works within the areas of “Musicology, Acoustics, Signal Processing, Psychoacoustics, Artificial Intelligence, and Human-Computer Interaction” (p. 1). Ferreira (2007) examined the idea that music technology coursework often focuses on content because of disciplinary challenges in defining the area and what it “as a subject entails – or should entail” (p. 29). This literature establishes a need to develop and refine pedagogies for teaching music technologies. The volume of information required for successful outcomes when working with music
technology needs careful consideration and often students require additional support (King & Vickers, 2007).

These disciplinary challenges are evident when teaching music technology within the area of popular music education. This situation can lead to some students having limited knowledge of how to operate music technologies, because their focus means that they do not fully engage with the topic. Investigating new delivery methods that support musicians to learn skills related to music technology could have the potential to improve their outcomes in popular music production. This is a skill that could be highly relevant to their career post graduation. Having a solid working knowledge of available music technologies allows students to engage in popular music production as working professionals after graduation.

2.4 Music Education

There is a growing awareness that the influence of technology has facilitated movement in the skill sets required for music industry success (Bartleet et al., 2012; Carey et al., 2006). This is provoking a reconsideration of how the music education experience is designed, to align with the outcomes required to remain employable in the contemporary industry. This suggests the development of self-directed learning skills increases student aptitude for success in the industry. In the context of the site of this study, there is a strong focus on practical activity, with students developing skills in popular music production through working on portfolios of music to align with the need of modern conservatoria to produce “multi-skilled and adaptable graduates who are self monitoring and self-directing” (Lebler, 2007, p. 205). In response to this developed an environment that facilitates “a learning experience within which students and teachers co-produce learning” (Lebler, 2007, p. 206).

Research suggests that post-secondary music education should move towards a model that supports the experience of the student (Graham, Dezuanni, Arthurs, & Hearn, 2015). Graham et al. (2015) argue that post-secondary music education models need to shift their focus from simply delivering information to facilitating learning through experience. They
propose that the widespread availability of information has led to “shifts in the nature and value of information; that, in fact, information in general is becoming less and less valuable” (p. 112). Further, they recognise that “there are apparently few limits to the degree of expertise a dedicated student can achieve through access to free online how-to videos” (p. 114). Graham et al. further acknowledge that many manufacturers of music technology products support the use of these products through on-demand resources. They suggest that popular music production is driven by rapid innovation. This is something that music education needs to consider.

Moreover, in the context of a university music school focused on the education of contemporary (as opposed to classical) musicians, the pace and scale of innovation in production tools and other instruments presents a perennial problem: relevance of the curriculum. The snail’s pace of committee- and timetable-dependent curriculum change in universities simply cannot keep pace with the rapid changes in an industry that is innovating perhaps faster than any other. Holistic, local, and action-based approaches to learning potentially solve these problems. (p. 116)

These ideas suggest that music education needs to be mindful of industry developments to continue to be relevant to student needs. On-demand learning resources should focus on keeping abreast of innovations to production tools.

2.5 Supporting Music Technology Education

Other studies highlight how technical support for music technology education can be beneficial to student outcomes (King, 2008, 2009a, 2009b). King (2009a, p. 137) evaluated the implementation of a “learning technology interface” (LTI) in a recording studio environment through a practical project in which students completed a task in the recording studio, and the LTI was made available to support them. Offering a specific perspective on supporting students to learn recording studio operation, the LTI was presented as a valuable pedagogical initiative. King (2009a) argues for access to relevant material on-demand to enhance learning is more beneficial than more conventional sources of information. The LTI
in his study was created to support students in the development of their technical skills. This example suggests that the development of students’ skills in music technology could engage with on-demand resources.

Research also supports the inclusion of on-demand resources through recognition of how users of music technology engage with learning (A. Bell, 2014; Slater, 2016). Outside of formal education environments, the learning processes employed by musicians working in “the project studio” could be of particular significance to developing pedagogy (Slater, 2016, p. 9). Slater (2016) recognises the “increasing access to ever more powerful technologies that allow music to be produced in increasingly diverse circumstances” (p. 9). The impact of the wider availability of music technology has seen the industry move from commercial recording studio spaces to a model of fluidity, where musicians create music autonomously (Leyshon, 2009; Théberge, 2004).

Increasingly, musicians find themselves in the role of musician/audio engineer as a working process. This has stemmed from the widespread availability of music technology tools and the improved sonic quality of DAW software (A. Bell, 2014). The consequence of these developments is that the method of learning and working in the project studio environment has evolved. Slater proposed that the adoption of self-directed learning in the project studio has meant that often these musicians “discover what skills and knowledge they need as they go along” (p. 12). Slater further comments that this is due to the nature and working methods of musicians working in the project studio environment.

Participants in a project studio motivate themselves to make music, though there might not be any pre-determined pattern for how this will happen and the eventual goal (whether to make a single track, an EP, or an album or what technology and musical materials to use) might not be known in advance. Furthermore, there may be no clear distinction between carrying out the creative activity and learning how to carry it out: they can be one and the same. (p. 12)

Engaging with popular music production techniques regularly combines with learning the approaches involved in completing a particular activity, signifying how the technical and
creative processes are intertwined through the ways in which musicians create their work. This approach to learning demonstrates synergy between using on-demand resources to support music technology education and the working processes generally employed by musicians.

Slater (2016) also discusses how, through the process of creating music, project studio musicians often find themselves exploring technical concepts and processes. What began as a session geared towards exploring musical material might veer off into a conscious pursuit to learn aspects of technical detail (including recourse to online instructional materials or a question posed on a social network or dedicated forum). (p. 14)

This research also suggests mirroring some of the natural self-directed learning strategies employed in the project studio to support music technology education (Slater, 2016). Slater’s research supports the inclusion of on-demand resource support, by reflecting the informal learning approach employed by popular musicians. It further theorizes on the design principles relevant to on-demand resource support. Throughout this research, Slater (2016) suggests that describing learning strategies as informal or formal is too simplistic, requiring further refinement. He then goes on to describe five dimensions of learning that can be used to develop pedagogical design. The five dimensions proposed by Slater (2016) incorporate intentionality, agency, patterning, experience/concept, and the socio-architectural dimension as stages of the learning process. Through integrating these principles, Slater (2016) suggests that,

Inflections of each of the five dimensions could lead to an engaging mix of tasks, teaching approaches, and learning activities that, although derived from an exploration of a specific example of creative music making practice, might also be relevant to other subject areas. (p. 24)

This has implications for the design principles of on-demand learning resources, which should consider how the working process interacts with the creative process. Through careful reflection on these processes the design of effective resources, which cater for these
dimensions of learning, can be achieved. These categories demonstrate alignment between Slater (2016) and the work of Green (2007), Folkstead (2006), and Cain (2013).

The five dimensions Slater (2016) proposed follow the stages of the learning process while considering the participants involved. Slater describes intention as the “direction of the mind either towards learning or towards the core activity” (p. 14). In other words what motivates the activity as a starting point. The activity is then influenced by the agency of the participant, described as “how intention comes about, who decides to embark on the project as a whole or who activates particular tasks within it” (p. 14). Patterning is the steps involved in the learning that is taking place, whatever the scenario. It can be intrinsically motivated or responsive to “immediate or emerging needs” (p. 15). Slater also suggests that while this is often an emerging territory, many projects are also sequential and have their own individual order. Experience and concept are the intersection of experience and knowledge development, as characterised by experiential learning. The nature of socio-architectural learning relates to the environment surrounding the learner. The overall suggestion is that post-secondary education in music could benefit from developing the movement between formal and self-directed learning spaces and activities, while delivering context to formal education through broadening the outlook to the wider environment (Slater, 2016). This relates to the provision of on-demand learning opportunities as a facilitator of learning for students learning in a very similar context to those working in a project studio environment. These ideas reinforce the notion that the design focus of on-demand learning resources should cater for culturally relevant and common student learning activities, through consideration of the processes involved in producing popular music or engaging with the use of music technology. Resource design that supports immediacy, through recognised patterns of working methodology, would be highly relevant in an on-demand context.

2.6 Enhancing Music Courses through Teaching with Technology

Researchers have suggested that the use of technologies in teaching music should be the subject of much more research due to the impact of technology on music teaching and learning (Burnard, 2007; Crow, 2006; Draper, 2008; Grant, 2013; Jørgensen, 2014; Salavou,
THE DESIGN PRINCIPLES OF ON-DEMAND LEARNING:
A DESIGN-BASED RESEARCH STUDY OF EDUCATIVE PROVISIONING IN POPULAR MUSIC PRODUCTION

This argument supports the development of on-demand resource support, given the widespread engagement with learning in this way outside of formal education. Some of the literature supports the idea that the use of technology can enhance music education (Burnard, 2007; Grant, 2013). While King (2009b) focuses on supporting music education through direct action initiatives, work undertaken by Draper (2007) within a music technology program suggests the value of a holistic approach to creative arts education. Draper discusses how traditional structured scientific modes of content delivery often create disengaged students, particularly in the creative arts. Draper’s work offers a perspective on the structuring of a music technology course in post-secondary education, and on how online technologies could support and enhance the pedagogy. A broad range of online initiatives encourages collaboration amongst the conservatorium community, allowing undergraduate students to have a chance at “doing the driving” for their own learning (Draper, 2007, p. 1). The idea of a “learning ecology” (Draper, 2007, p. 1) is developed where both student and teacher interact through online resources, allowing for more contextual understanding of music technology. Students participate and exchange creative works in an environment that supports collaboration and peer review through the use of technology in a music education environment.

Online collaboration is also relevant to the area of music technology education. Draper (2008) explored the way that the Internet is changing and “re-defining music careers” through use of social media or “Web 2.0” (p. 137). Through social networking styled ontology, Draper details a dynamic environment designed to create an authentic context for music technology coursework. The design principles of on-demand learning could potentially be influenced by delivery mode, whether through a school-based learning management system (LMS) or through social media delivery methods like Facebook or YouTube. This is because delivery through a LMS does not focus on facilitating peer-to-peer interactions, while social media styled delivery has peer interaction as a central feature.

Online community learning is also the subject of an investigation by Waldron (2011) who examined the importance of the “community of practice” and the role of informal
learning over the Internet (p. 97). Waldron discusses the need to evaluate and further develop research methodologies to interpret these new ways of working. Macedo (2013) suggests that technology has changed the expectations of students, and this is directly relevant to music technology because of the role technology plays in this area. Through gaining this additional perspective, students will develop enhanced critical and perceptual skills, which in the creative arts are necessary to deliver successful outcomes. The development of supported environments for learning these skills also benefits the development of students’ self-directed learning skills. Given the developmental nature of technology, developing these self-directed learning skills will prepare students more effectively for working as professionals outside of the education environment. The works of Grant (2013), Burnard (2007), and Draper (2008) further supports the inclusion of opportunities for teaching through technology into the music curriculum. Outside of education the use of technology is common in the music community. Supporting music education with technology moves pedagogy away from focus on the teacher to focus on the student. The broader impact of information exchange enabled by technology continues to build the argument for the importance of embracing this in music education. These authors also emphasise the sense of community that online environments bring into play, which can enhance learning opportunities through peer learning. This has potential design implications for on-demand learning resources, because while self-directed learning is significant in popular music education, so is the impact of peer learning (Lebler, 2008).

2.7 Informal Music Technology Support

There are numerous examples of online music technology tutorials that have the potential to inform the design principles for the development of on-demand resource support (Ableton-Live, 2017; Avid, 2017; Gearslutz, 2017; Universal Audio, 2017). Outside of the formal education environment, many providers of music technology equipment offer informal support for their users through online tutorials and forums. It is common practice for users of music technology to engage with these tutorials and forums to support their music creation activities. For example, Universal Audio (2017) is an established music
technology company that manufactures classic analogue hardware devices. In recent years they have expanded their range and now offer an extensive array of audio plug-ins, audio interfaces, and plug-in accelerators. Though not unique in their approach to on-line resources, they provide a typical example of how music technology manufacturers support their client base. Through their support page (https://help.uaudio.com/hc/en-us/categories/201458843) offer a range of screen capture videos that show the processes for configuring DAW set-up and for troubleshooting other common issues for Universal Audio products. These resources are also available via YouTube (https://www.youtube.com) and shared through their Facebook page. Universal Audio’s model of support is a common example found in the industry. Providers often incorporate these forms of resources with user support forums.

Another company exemplifying on-demand support is Avid (2017). Avid manufactures and develops tools for editing and recording both video and audio. They are the developers of the Pro Tools audio software, a global industry standard DAW. Avid offers a range of services consisting of video tutorial content combined with extensive support forums where users discuss a range of issues mediated by Avid support staff. The support forum is a common feature of many music technology web pages and incorporation of some form of support forum could be a relevant design principle for the development of on-demand resources. Users of support forums engage with a range of topics related to the use, installation, and configuration of a range of music technology equipment. One of the other functions of these online tutorials is to release new and relevant information related to specific products.

Avid (2017) DAW Pro Tools has become increasingly complex in its functionality. Pro Tools has new features that develop the scope of the tools available with each upgrade. Each release of new features necessitates a range of training videos to share the processes involved in using these features. Maintaining a current knowledge of the working procedures available with each Pro Tools release provides users with new tools to potentially improve their workflow. Resources that provide the latest information have a significant role to play
in keeping users current in their music technology usage. A design principle drawn from observation of this site is the incorporation of information that enables users to operate new technologies. Maintaining resources that provide the latest information regarding new equipment is highly relevant to effective design.

Web sites where users engage to problem solve, learn, and discuss music technology can serve a more general function. The website Gearslutz (2017) is an example of this, covering professional audio equipment from a range of manufacturers and developers. Hosting a forum, equipment reviews, database, and a market place where users of professional audio equipment engage in discussion and exchange information is it’s primary function. It also provides video demonstrations of professional audio equipment in conjunction with other information. One design characteristic that stands out is the focus of the site on enabling contributors to share their knowledge with other music technology users. This type of online community has relevance to aspects of on-demand research design, which have the potential to build localised communities to support music technology education.

One DAW incorporates on-demand education into the software itself, where operation tutorials are accessible via the user interface. Ableton Live (2017) is a DAW that focuses on mixing audio loops and samples to create electronic styled music. The focus in the field of electronic music is on do-it-yourself rather than group collaboration. Providing tutorials through the software highlights the importance that Ableton Live (2017) place on training their users. It supports the exploratory nature of music production as discussed by Slater (2016). The incorporation of resources within the software suggests that the accessibility of information is a fundamental principle of design.

These informal music technology support resources demonstrate the high level of engagement that the industry has with learning through on-demand resources. The design principles that these resources exhibit have the potential to inform resource design for supporting music technology education. The focus on demonstrations, troubleshooting and technical support suggest that a fundamental design principle is that resources need to offer
solutions through unfamiliar situations. The emphasis on having the latest information highlights the need for resources to be up-to-date with emerging tools. Maintaining a focus on networked learning through forums reveals the importance of peer-to-peer and peer-to-expert interactions within the online space. Integration of this form of resource is also a highly valuable design principle. Finally the need for immediacy is also integral to effective design. Delays in gaining access to information can be problematic, therefore minimising response times is also a key element of design. Developing these resources to support students learning skills in popular music production could be a natural extension of the informal learning approach relevant to the industry as a whole. Through offering on-demand support within a music technology program, aspects of a real-world experience could be incorporated into pedagogical design.

**2.8 Technology in Post-Secondary Education**

Technology is increasingly challenging post-secondary education, while reconceptualising the way that learning is rationalised (Saljo, 2010). This situation has been influenced by the way the modern student engages with learning. Since the turn of the millennium, students have increasingly seen technology as an integral part of their world (Oblinger, 2003). Oblinger (2003) believed that educators needed to develop an understanding of how the modern student views education and technology as an important factor in facilitating learning. Through an understanding of this, effective design principles can be developed.

Designing effective technologically enabled learning environments that support and engage students in learning is increasingly important for post-secondary education providers. For example, some research has proposed that post-secondary education can improve student engagement through the use of digital technologies, which increase motivation (Sammel, Weir, & Klopper, 2014). This study investigated the implementation of digital technologies on student motivation and engagement within undergraduate teacher education courses. It has also been recognised that the development of learning design needs to keep in touch with the emerging technologies that support them (Phillips, McNaught, & Kennedy, 2012).
Therefore, new ways of engaging with and supporting learning need to be trialled and research conducted to evaluate the outcomes. This will lead to the development of new design principles for educative provisioning that aligns with student expectations. In conjunction with the earlier investigation on the impact of integrating technology into undergraduate teacher education Klopper and Weir (2015) investigated implementing “instructional delivery technologies” as a way to support music teacher education (p. 42).

During this study a range of digital technologies were introduced with a two cohorts of pre-service primary education students taking a core music education course. The first cohort included 127 students, while the second cohort included 119 students. Surveys and focus groups were conducted to assess the outcome of the intervention. Eleven students participated in the focus group for the study. Klopper and Weir (2015) concluded that augmenting music teacher education with technology had the potential to increase student engagement and learning outcomes, through addressing students’ need for an assortment of delivery modes. This research project also utilised a design-based research methodology to assess the learning outcomes of a pedagogical intervention through educative provisioning with technology. Klopper and Weir (2015) support the idea that technology should be engaging students in learning. Informing course design with contemporary methods of information exchange has the potential to deliver an engaging learning environment for the student.

Teaching with technology is not without its challenges, however, educators need to address a range of issues in order to effectively blend “online and offline activities” to provide students with an effective mix (Phillips et al., 2012, p. 3). Developing knowledge of the intended users of technology tools has the potential to inform relevant design principles for on-demand resources. Prensky (2001) conceived the term “digital natives” (p. 1) early in the millennium to describe the technical abilities of those born after 1980. His commentary argued that digital natives had an intuitive grasp of technology due to early exposure to technologies. These technologies had become part of day-to-day life for this generation. Prensky argued that this generation, born in the digital age, had thought processes that were
Digital natives are reported to “think and process information fundamentally differently” from those described as “digital immigrants” (Prensky, 2001, p. 2). Yong and Gates (2014) also defined digital natives as non-linear thinkers that like to receive information quickly, while exhibiting strong multitasking skills. While these arguments suggest that technology is influencing learning processes, access to information facilitated by technology also contributes to the development of these characteristics. The sharing of data has enabled the development of a knowledge society, which has influenced patterns of information exchange (Wessels, Finn, Wadhwa & Scevinsdottir, 2017). However, there have been challenges to the idea of digital natives. Research cautions that youth is not a prerequisite for technical ability, and that younger users of technology are not necessarily experts in the area. The presumption of the technical ability of young technology users has been the subject of various academic research (Bennett & Maton, 2010; Margaryan et al., 2011; Thompson, 2013). While the use of technology is becoming pivotal in the post-secondary education environment, it is important not to generalise the technical abilities of these technology users (Bennett, 2012). It is argued by Bennett (2012) that there is “significant diversity in the technology skills, knowledge and interests of young people” (p. 1) and that further research into the area is needed so as to not generalise digital natives as a group of highly tech savvy individuals (Bennett, 2012, p. 3). One empirical study investigated the use of digital technologies by students who fall into the digital native demographic. This study was conducted by sending an on-line survey regarding their technology use to 3000 freshmen at large American university. From this cohort the researchers received responses from 388 students. Thompson (2013) concluded from this study that the vast majority of these technology users engaged mainly with lower level technology -- communications and web resource technologies -- during their activities. Thompson summarised the findings by suggesting that the digital native generation was often not using technology to its full educative potential and proposed that students needed
more guidance in the use of these technologies, with teachers needing to explicitly scaffold students to use some resources for learning.

While the claims about the digital natives often imply that students would be self-sufficient learners if they were simply “turned loose” with the right technology, findings from this study highlight several areas where teachers can play a critical role in preparing students for success in the digital world. Digital native students may need scaffolding from teachers before they will go beyond the rapid communication technology they are most comfortable with and learn the wide variety of technology tools that are important for productivity in school and the workplace. (Thompson, 2013, p. 23)

The patterns of student engagement indicated by Thompson (2013) have implications for educators who seek to support and enhance post-secondary education facilitated through technology. This is that while many students engage by using technology, they often have different strengths and weaknesses. Margaryan et al. (2011) found that students often did not have the required knowledge and skills to direct their own learning, recommending that further contextual research into the delivery of technological education tools was needed to establish their effectiveness through active experimentation with these technologies. Providing students with learning opportunities mediated by technology can be engaging and can effectively support learning. However, the research also suggests that careful consideration of offering students opportunities to support their on-demand learning should be incorporated into design (Margaryan et al., 2011).

There are other trends in post-secondary education that deliver a strong argument that more technologically enabled learning opportunities are appropriate for students. The first trend is that widespread access to technology is having a continuing impact on how higher education is being delivered. The second trend suggests flexible learning is an important consideration for time-poor students. Some studies have noted that the future direction of post-secondary education is at a turning point, where moving towards a model of increased flexibility for students is essential (Johnson et al., 2014). This shift allows students the
flexibility to choose when and where they engage with learning, as well as their individual learning goals (Johnson et al., 2014). This view is reflected in the literature where increasingly the fluidity of the learning process is presented as the way forward for education (Adams Becker et al., 2017).

Another technologically enabled learning design, “the flipped classroom”, is already becoming a more visible part of the higher education environment (NMC, 2017, p. 5). This design allows the learner to preview course content at home, which means less face-to-face class time and allows for more active learning engagement (NMC, 2017). Through the adoption of more flexible learning resources, students are provided with more learning opportunities to support their activities. Esnault (2007) while reviewing the influence of technology on education discussed how the process of learning and teaching had changed. In her view the increased availability of information and communication technologies (ICTs) had provided more learning opportunities. She argues that because of the range of ICTs readily available, students are enabled to achieve results using a range of plug-and-play technologies. The recognised implication of this is that learning designers using e-learning need to flip the pedagogical emphasis from teaching to learning, through the integration of mobile technologies into formal learning systems. The initiation of on-demand resource learning opportunities supports the development of education initiatives in this area. Through offering more flexible learning opportunities, more engaging learning strategies can be developed.

The literature validates the notion that the increased adoption of on-demand learning strategies is highly relevant to many post-secondary education providers. Aligning the learning experience with the use of technology offers many additional benefits to students including increased flexibility in learning, fewer contact hours, and the opportunity to engage with learning opportunities that accommodate a variety of learning styles. Overall, there has been a major push on behalf of institutions to align pedagogy with more progressive, flexible learning resources (Griffith University, 2017). The development of on-
demand learning opportunities has the potential to address these needs through the incorporation of more flexible learning opportunities.

**2.9 Networked Learning and Connectivity**

Networked learning and connectivity is an area that has been influenced by the pervasive spread of technology. Rainie and Wellman (2012) discuss the impact of technology on the development of community, which has enabled broader networking capability for individuals. This “networked individualism” enables “access to a greater variety of people and to more information from a greater variety of sources” (Rainie & Wellman, 2012, p. 13). This acknowledges the power of the network in learning. The sense of a community strongly defines this strand of the literature. Jenkins (1992) initially developed the term “participatory culture” to define the social interactions of communities of fans (p.3). Jenkins, Ford & Green (2013) propose that this term has now evolved to describe “a range of different groups deploying media production and distribution to serve their collected interests” (p. 2). Siemens (2005) also discusses how technology has impacted on learning, theorising that “connectivism” has evolved into a relevant education theory that fills the gaps that social constructivist learning theory does not (p. 4). Siemens (2005) proposed that other education theories focus on the individual, ignoring the role of “learning that is stored and manipulated by technology” (p. 2). This theory has implications for education, because of the potential of these technologies to educate and inform. Van Dijk (2014) discusses how developing “digital skills” can enable participation across a number of areas relevant to personal development, which is core to living in our “information society” (p. 45). Participatory culture has also been the subject of research; because of the educational potential that participatory culture has for facilitating learning. Waldron (2013) discusses the impact of “user-generated content, YouTube, and participatory culture” on music learning and teaching in on-line communities (p. 257). It is also suggested by Waldron that these trends have potential implications for music learning and teaching in “offline contexts” which “requires exploring new models of music learning and reflecting upon the implications these new approaches might have for music teaching” (p. 272). Waldron
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(2016) further explored these concepts while investigating the convergence of on-line and off-line music making for Irish traditional music makers. This discusses the extension of informal music practices as codified by Green (2001) into what Waldron (2016) terms “informal music practices 2.0” (p. 93). Facilitated by access to networked learning through participatory culture, musicians are able to supplement their informal learning activities through learning within on-line communities. This research studied the convergence of on-line and off-line context and the supporting role that can be played by on-line music learning. Waldron. Mantie, Partti and Tobias (2018) explore the idea of integrating principles of participatory culture into music education. They propose that participatory culture has a place in music education, through engaging in practices relevant outside of formal music education. They summarise this position by stating: “participatory culture may provide insights necessary for music education to better enact the espoused values of access, inclusion and lifelong impact.” (p. 300).

2.10 On-Demand Learning

Tozman (2012) defines learning on-demand as “a critical moment of need, when a person really wants knowledge about a specific topic to help them through that moment” (p. 1). He contextualises this approach to learning, defining it as “pulled learning because the information required is dynamically pulled by the individual” (p. 1). This is a shift away from the traditional education process that delivers prepared material where “a person is exposed to new knowledge regardless of his or her immediate needs” (Tozman, p. 1). This is creating extended learning communities, and arguably changing the nature of how and when people learn. The spread of influence of on-demand learning is now moving at a rapid pace thanks to the availability of mobile technologies (Johnson et al., 2014).

Access to information technology has allowed those involved in post-secondary education to engage with learning skills and solving questions on-demand. Research suggests that the role of technology in education is at a tipping point, and that pulled or on-demand learning is becoming a more relevant delivery model for post-secondary education (Johnson et al., 2014) because of the expanded availability of mobile technologies which
provide widespread access to a wealth of information. Therefore, addressing the role that technology plays in supporting learning has become a key focus for many institutions in the post-secondary education sector. A range of education researchers have proposed that post-secondary education needs to keep pace with the world and with the ever-increasing influence that technology is having on education (Bennett & Maton, 2010; Edwards, 2012; Johnson et al., 2013). The extensive access to information provided through widely available mobile and web-based technologies has given learners the opportunity to access information on demand (Tozman, 2012). These developments are driving the evolution of new models of learning and teaching because of the rapid pace that learning environments are setting outside of education (Tozman, 2012).

The process of learning is being influenced by technology in a number of ways. Tozman (2012) proposed that learners who pull learning on-demand have deeper learning experiences, because of the relevance and application of the learning. Other researchers in the area argue that learning on demand delivers enhanced learning outcomes for the student. For example, Trondsen and Vickery (1998) proposed that because learning is applied contextually through the learning-on-demand model, knowledge retention is significantly superior to “lecture-based learning models” (p. 171). They argue that the incorporation of visual information resonates more effectively with the majority of students who absorb information more readily in this format. Trondsen and Vickery view the traditional “hierarchical model of knowledge transfer” as out-dated in an age where there is more focus on “empowerment, individual accountability and self-directed learning” (p. 174). The development of an active learning environment delivers deeper learning experiences, and as a result delivers more thorough understanding of the subject matter (Cherney, 2008).

Taminiau et al. (2015) propose that on-demand learning environments need to simultaneously develop the self-directed learning and domain-specific skills of the learner. They argue that without skills in self-directed learning and task selection the learner will be unable to navigate the learning environment. They generally felt that on-demand education “can be beneficial for learning if learners have the self-directed learning skills necessary for
dealing with this type of education” (p. 419). Kicken, Brand-Gruwel, and Van Merriënboer (2008) suggest that to assume that students have self-directed learning skills is not wise, so providing relevant information to help students to develop these skills should be incorporated into the learning environment. Kicken et al. also argue that students require some scaffolding in the use of on-demand resources.

A common mistake in on-demand education is to assume that student who enter into it already have well-developed self-directed learning skills. Instead it is better to assume that most of the students have not yet sufficiently developed these skills. Therefore, the learning environment should provide all relevant information and scaffold experiences to help students select their learning tasks and develop their self-directed learning skills. (p. 236)

While on-demand learning is becoming more common, there is a demonstrated need to incorporate self-directed learning skill development into pedagogical design. There is a significant amount of evidence to suggest that on-demand resources could provide valuable support for learning. Maintaining an awareness of the availability and application of these learning tools is important for maximising their impact on the audience.

2.11 Just-in-Time Learning

One approach to delivering information on-demand is through just-in-time (JIT) learning. JIT is a pedagogical approach where the key focus is on the development of knowledge and skills through an active learning environment (Digital Learning, 2010). This active approach to facilitating learning aligns with other learning theories, such as experiential learning. Experiential learning suggests that experience is the key element in building knowledge and should be central to the learning process (Kolb, 1984).

Though literature in the area of JIT learning is limited, this pedagogical approach demonstrates synergy with how practitioners learning skills in music technology often engage with learning. Slater (2016) proposed that musicians working in project studio environments often “discover what skills and knowledge they need as the go along” (p. 12).
Brandenburg and Ellinger (2003) suggest that JIT learning “has not been well defined in the literature, in part because it does not refer to a particular learning theory or method, nor is it in any specific process or technology” (p. 309). JIT learning is often employed as a model for training in corporate education, but limited research exists about its potential for delivering learning opportunities in higher education (Sambataro, 2000). In the corporate world, JIT is about delivering results by providing training quickly and in a way relevant to the workplace, where time is of the essence (Weintraub & Martineau, 2002). In this field it has been established that almost 80% of what people learn about doing their jobs happens informally, while 20% comes through training programs, therefore making it questionable why more training is not provided through the approach (Weintraub & Martineau, 2002). JIT learning is not a new concept and the possibilities of the paradigm as an education approach have existed for a number of decades, as Gifford (1992) writes: “Just in time learning systems exploit the potential of multimedia to make interactive learning more immediate, more compelling, more closely attuned to the needs and learning styles of individual students” (p. 49).

Brandenburg and Ellinger (2003) identified the main defining features of JIT learning as “anywhere, anytime learning that is just enough, just for me and just in time” (p. 309). During the formative years of the Internet, the possibilities of easy access to information were exciting, as the potential for information technology to become a significant education tool became a reality. The scope of technological development has progressed significantly since then, together with the advent of more sophisticated mobile technologies (Edwards, 2012). Certainly, it has been recognised that JIT learning has a technological approach at the core of its ideology, as most of the delivery methods relate to the development of ICT tools and processes (Brandenburg & Ellinger, 2003). JIT learning strategies have also delivered solutions to businesses that sought more flexible options for training staff. In this context, Sambataro (2000) proposed that on-line tutorials offered learners the potential to “solve problems, perform tasks or quickly update their skills” (p. 50).

These ideas broadly define JIT learning’s pedagogy as learning that happens in
context; however, JIT learning has a range of specific approaches to information delivery. The broad pedagogical approach of JIT learning appears straightforward enough: to deliver relevant information on demand while relying on interaction with a task or problem.

Digital Learning (2010) proposes the idea of JIT learning as a paradigm shift in pedagogy towards “problem solving and competence based learning environments” (p. 1). They suggest this approach is fuelled by web technologies, which utilise a broad range of technological, interactive, and interconnected environments to enhance information delivery. These web technologies can take many forms. Digital Learning (2010) acknowledged the interconnected, collaborative knowledge facilitated by “community activities such as blogs, wikis and moodle” (p. 1). It also recognises that the emphasis of this pedagogical approach is on providing relevant resources at the right time, or as an integrated part of the workflow. The learning resources in these cases should be “aligned to people’s needs and preferences” (p. 1). Digital Learning (2010) further suggested this knowledge should come through “a learning system that integrates the e-tools, e-resources and e-knowledge with the learner preferences minimises the gap between the learning and application offering the context oriented help (p. 1). The learning outcomes of the JIT learning style are the subject of other commentary, with the proposal that it works effectively in delivering outcomes. Tulgan (2013) argued that people learn more effectively when applying knowledge or learning skills in the context of “learning just in time” (p. 7) and proposed that this style of learning produces a results-driven outcome. Weintraub and Martineau (2002) also suggested that JIT learning is a more effective pedagogical tool for learning skills. However, they also suggested that corporate systems have remained behind the times in sticking with existing corporate training models which, while valuable, are not as adaptable to the fluid training workers need in the information age. Brandenburg and Ellinger (2003) stated that JIT learning was a response to some other major stimuli that happened around the turn of the millennium, these trends being “the move towards the virtual workplace, the growth of knowledge capital, and the increasing rate of change” (p. 308).

Weintraub and Martineau (2002) acknowledge that one way of structuring JIT
learning is through developing “communities of practice” allowing participants to “create the knowledge they need, select the right means to structure and exchange that knowledge, and assess knowledge gain and application” (p. 56). While this appears to be potentially self-sustaining, the need for effective facilitation is also something that Weintraub and Martineau consider is vital to these learning environments. This would allow the training providers to focus on acting as “learning counsellors” who “spend less time focusing on traditional training, and more time ensuring that the community and its members are travelling the right learning paths and have the appropriate resources” (Weintraub & Martineau, 2002, p. 56).

There are other aspects of JIT learning environment design that require consideration. Brandenburg and Ellinger (2003) also propose that the JIT learning system needs to be able to anticipate training requirements rather than respond to these needs, requiring that the necessary tools be in place within the system.

Wenger, White and Smith (2009) discuss the implications of technology stewarding on communities of practice. Technology stewarding within JIT learning communities requires consideration because of the need to facilitate effective management of JIT learning environments. Wenger, White and Smith (2009) propose that technology has the potential to be adopted or discarded by communities, based on how useable they find the new technologies to be. Technology stewards fulfil the role of identifying “a community’s perspective to help a community choose, configure and use technologies to best suit its needs” (p. 24). Within a community of practice technology stewards also fill the roles of assisting in the areas of understanding, awareness, selection, installation, adoption, transition, and use for technology (Wenger, White and Smith, 2009). Design of JIT learning environments require successful technology stewarding to build communities of practice.

While the benefits of JIT learning environments are significant, there are potential challenges involved in this approach. Weintraub and Martineau (2002) note that responsibility for learning has shifted quite considerably towards the learners in a JIT model. This means that while participation in these environments is particularly important in today’s world, unmotivated students can fall behind through not participating in the required
activities or training (Weintraub & Martineau, 2002). Considering the design elements of a JIT learning environment could offer some established design principles that could be adapted to deliver on-demand training environments for supporting music technology education. Brandenburg and Ellinger (2003) suggested that integrating JIT learning resources into the workflow is an important feature of the pedagogical approach in the workplace education environment: “The concept of JIT learning is not simply associated with knowledge management tools that lead to knowledge generation and sharing in collaborative work platforms but embeds the tools into the actual work processes” (Brandenburg & Ellinger, 2003, p. 312). Accessibility of JIT resources is an important design principle to consider. This will increase the potential for students to access the required information at the right time.

Learning in popular music production can be supported in a multiplicity of ways, through offering learning opportunities related to the tools that the students are using throughout the recording process. Often, operating a recording studio requires students to integrate various pieces of hardware and software to record or mix audio. Integration of JIT information into the recording environment could involve providing students with a range of accessible resources that offer tutorials on commonly used techniques or applications. JIT learning has significance to this research project as it demonstrates that on-demand access to information for skills-based training is an established pedagogical approach. While for many users of music technology this does not happen formally, it does happen informally through access to the vast amount of resources available through the World Wide Web.

JIT learning has relevance to the context of this project because of the institutionalised environment within which BPM students work. Often, working in the BPM studios involves students engaging with a range of commonly used equipment and set-up procedures. Providing students with resources that assist them with their workflow will allow them to engage with JIT learning. This means that the design principles need to align with the context of the learning as a fundamental consideration.
2.12 Mobile Learning

The widespread adoption of smart phones has led to an environment where many students have access to on-demand information through the technology they carry with them. This is certainly the case with BPM students, who generally carry smart phones and often engage with these devices to network and gather information. These technologies have significant potential for delivering technical information to the BPM student cohort through providing JIT learning opportunities. The field of mobile learning is a developing area, with a high degree of relevance to the field of music education (Chen, 2015; Wallerstedt & Hillman, 2015).

Research and literature in this area continues to propose that a connected world through mobile technologies is leading to broader changes in learning styles. Mundie and Hooper (2014) believe that the advent of mobile learning is changing how knowledge is defined, which has meant, “we should revisit our notions of how knowledge is acquired” (p. 11). Ledward and Hirata (2011) highlight the challenges presented by the access to the vast quantities of information that mobile technologies facilitate. The ability to decode large amounts of information and make quality judgements has become necessary because of broad access to information through mobile technologies (Ledward & Hirata, 2011). This situation supports the argument that the provision of a curated on-demand learning resource environment has potential to enhance delivery strategies, through engaging students using information-gathering tools they are familiar with outside of formal education. Through providing on-demand learning resources via mobile learning technologies, the on-demand resource design then caters for the learning style of the user demographic.

There are also arguments to suggest that the provision of mobile learning opportunities has the potential to build students’ skills in other ways. Mundie and Hooper (2014) argue that mobile technologies should be “used to develop 21st century skills” (p. 12). They propose that the use of these skills are central to the way that learners engage with information, and that this could benefit formal education.
Such skills imply the ability to learn quickly by cultivating knowledge networks that support information gathering practices in authentic environments, applying mental filters to find, sort and extract information, using that information to solve problems, and evaluating the results of one’s own work. (p. 12)

Central to these ideas is the personalised nature of mobile learning, which is highly individual and has the ability to tailor information to particular needs (Mundie & Hooper, 2014). Delivering on-demand resources through mobile learning aligns more effectively than standard computer-based instruction with the JIT nature of the context. Martin and Ertzberger (2013) conducted a study with “109 undergraduate enrolled in pre-service instructional design and instructional technology courses” (p. 76). They focussed on “the specific aspect of mobile learning termed here and now mobile learning” (p. 77). This was because they considered that “here and now learning has the ability to engage learners because of its authentic learning and context based applications” (p. 77). During this study, Martin and Ertzberger also identified a range of characteristics identified as “ubiquitous learning” to implement the project (p. 78). These characteristics included:

- Urgency of learning need (on-demand and just in time)
- Initiative of knowledge acquisition (providing information to learners timely request)
- Situation of instructional activity (learning embedded into the flow of everyday activities)
- Context awareness (interaction controlled by context (user location, time, activity etc)
- Self-regulated learning (learners actively control their learning process)
(Martin & Ertzberger, 2013, p. 78)

Using the identified principles, the study sought to evaluate student achievement and attitudes to using mobile devices versus computer-based instruction. Three groups of students were provided with I Pads, I Pods and access to computer based instruction to study the characteristics of five art works. Then students completed a pre-test of ten multiple-
choice questions and a post-test of the same questions. While the study found that student achievement was one mark higher using the computer-based instruction method, student engagement was improved through use of mobile technologies (Martin & Ertzberger, 2013). It was noted that learning outcomes over time could potentially improve through the enhanced engagement facilitated by using mobile technologies.

Mobile learning has also been the subject of research in the area of music, with it already being recognised as a useful tool to supplement learning. In one example of this, Wallerstedt and Hillman (2015) investigated the use of mobile phones by secondary school music students rehearsing in pop bands, as part of the curriculum in a Swedish school. The researchers suggest that mobile phones were the learning tool of preference of these students, even though they also had access to a laptop throughout the project. This project observed 47 students learning parts during rehearsals and recognised that the participants engaged with their mobile phones in preference to the laptops provided by the school. This practice was supported by the teaching staff, who actively encouraged these students to look for information on their phones to assist with learning song arrangements and parts. Wallerstedt and Hillman’s research highlights the intersection of formal and informal learning strategies in the area of music.

Other research has recognised the significant impact of informal learning in the area of popular music and the natural learning strategies often employed by popular musicians (Folkstead, 2006; Green, 2007; Lebler, 2007). While the research highlighted that students brought their own personal learning strategies to the classroom, it was noted that some guidance by teaching staff was needed to “bridge the experiences and the skills they develop inside and outside of school” (Wallerstedt & Hillman, 2015, p. 90). Chen (2015) conducted research into the learning of aural musical skills through mobile devices, concluding that mobile devices assisted students with developing the required intrinsic motivation to assist with learning aural skills.

These research projects support the argument that mobile delivery of on-demand learning resources is a highly relevant design principle. Mobile learning offers an engaging
source of resources for student in the creative arts. On-demand learning resources demand responsive learning tools that allow just-in-time access to information. Learning opportunities delivered through this medium would allow students to engage with contextualised information to support their learning activities. It has been recognised that this approach has the potential to support the activities of musicians, thereby supporting the theoretical basis of this project.

2.13 Mobile Learning Design Principles

The development of design principles for sharing education opportunities for mobile devices is an established field of study (Banga & Weinhold, 2014; Gu et al, 2011; Lechler & Hosack, 2014). The main design principles emerging from these researchers relate to the accessibility of the information available through mobile devices. There is a general sense that fluency of information flow is the key to effective design.

Mobile interaction design focuses on user reaction and the patterns of engagement when using mobile applications (Banga & Weinhold, 2014). Gu et al. (2011) in their study sought to identify “the value of following a set of design principles to create usable learning materials for learners on the move” (p. 205). One of the main focal points of their study was the sharing of resources for solving problems or developing skills whenever required to assist with daily life. Through this study Gu et al. proposed a series of design principles. The first design principle is that “content should be practical so it is easy for users to engage with while still in the flow of their routine daily performance” (p. 206). This design principle is mindful of the nature of mobile phone use. The second design principle is that content needs to fit into usable time frames, allowing the user sufficient opportunity to engage with the subject (Gu et al., 2011). These content items are identified by Gu et al. as “small, self-contained and granular learning objects suitable for mobile delivery” (p. 207). Gu et al. found that the incorporation of these design principles into the context of their mobile phone learning applications was important: “The results show that effective implementation of practical and micro principles is highly valued because urgent needs arise while on the move.
Lecheler and Hosack (2014) identified seven design principles for the development of mobile learning applications. These principles considered the following areas: mode of interaction, context of use, scope, data management, mode of access, design scale, and incentives. The first principle proposed by Lecheler and Hosack is to make use of visual information to counteract the limited screen size of mobile devices. This is a consideration of the mode of user interaction with the mobile application. They suggest that in consideration of this limitation designers need to come up with interesting or “novel” ways of displaying data and other information (p. 91). This form of “information visualisation” combines the “use of pictures, colors, symbols and words to communicate complex information in a way that is clear, compelling, and convincing” (p. 89). Lecheler and Hosack also suggest that designers need to consider the context in which the mobile application is used. In this respect these researchers proposed that interaction with mobile application software is “tied to self-directed and informal learning” because the “interactions with software also occur more frequently and in less structured ways” (p. 92). There is also the suggestion that the scale of the design needs to be relevant to the intended device: “One way to accomplish this is to remove unnecessary content areas not contextually relevant to the learner based on the specific device they use” (p. 97).

Another design consideration that Lecheler and Hosack (2014) propose is the use of “modularity” (p. 92) as a part of the design, which can enhance the capability of the mobile application. This design component is the ability to integrate content from “existing technologies or applications in order to perform a specific function” (p. 92). This is a relevant design principle as there are a number of applications that could integrate into on-demand resource development. Complementing the design with modular components could allow sharing across multiple platforms, which would be an effective use of resources. Lecheler and Hosack note that consideration of the intended user group can influence the design of the mobile application. In order to facilitate this, “the designer should fully
understand their audience, and how they will be interacting with the environment being designed” (p. 96). Understanding the mode of access by the user group, whether they be a large unknown group of users or a small school- or workplace-based group the designer can provide a more contextualised experience for users (Lecheler & Hosack, 2014). This is a design principle reiterated by Banga and Weinhold (2014) who discuss the idea of catering to the intended user base as a design principle. It has also been suggested that the needs of users with disabilities should be considered when developing the design of mobile applications (Banga & Weinhold, 2014; Lecheler & Hosack, 2014). Banga and Weinhold (2014) advise that one way of meeting the requirements of different sets of users is to develop “personas” of user types, crafting design considerations based on the characteristics of these user types (p. 33). It is also important to anticipate the technical abilities of these users, as not all will have a great depth of technical ability (Lecheler & Hosack, 2014).

Lecheler and Hosack (2014) acknowledge that consideration of the design scale is also highly relevant to mobile application design, because “learning environments are commonly accessed using mobile devices that are significantly underpowered when compared with modern desktop computers” (p. 97). In order to compensate for this, designers need to “remove unnecessary content areas not contextually relevant to the learner” to minimise the screen clutter and information stored in the application that can potentially slow the device (Lecheler & Hosack, 2014, p. 97). This consideration is also discussed by Banga and Weinhold (2014), who propose that the responsiveness of the application is significantly important. They maintain that a key design consideration is that mobile applications should be “simple, easy to understand interfaces and user interactions that are readily apparent and require little thought” (p. 35). Otherwise, the risk is that the application will be discarded amongst the overabundance of other applications the user has stored on their mobile device (Banga & Weinhold, 2014). Banga and Weinhold also note that it is important to consider the situation that requires the application to be used: “As a designer, you must anticipate where your application will be called upon if you want to provide the best experience” (p. 37).
Overall, the intended group of users need to find the application “engaging, coherent and easy to use” as a basis of good application design (Banga & Weinhold, 2014, p. 37). Rigorous testing of the application with a group of users should be incorporated as a part of the design process. Through gathering feedback and refining design elements, better, more efficient design can be achieved (Banga & Weinhold, 2014). Designers also need to be mindful of the movement of the hardware and software used by the mobile application, as these elements are constantly changing (Banga & Weinhold, 2014). Maintaining application design through refinement based on the movement of operating systems becomes vital in maintaining the usefulness of the application. It is also good practice to consider the design of popular, well-known applications, which can inform elements of design (Banga & Weinhold, 2014). The applications developed by prominent digital companies like Facebook and YouTube are adopted by a wide variety of users, so elements of interaction design incorporated by these applications can inform design (Banga & Weinhold, 2014).

2.14 Social Media in Post-Secondary Education

Social media is one of those most prevalent forms of information exchange in modern society. This is now beginning to influence post-secondary education, with faculty engaging in social media as a part of their professional activities (Moran, Seaman, & Tinti-Kane, 2011). The design elements of social media could inform the development of design principles for on-demand resources. Outside of post-secondary education the rapid expansion of social media networks are reimagining the way users approach the Internet (Selwyn, 2012). Selwyn (2012) advances the idea that education providers have no choice but “to catch up with this world of social media applications and social media users” (p. 1). In his review of the state of influence of social media on higher education, Selwyn discusses a number of reasons why it has become significant and an important influence to consider. Initially, Selwyn proposed that the major factor contributing to the movement is the sheer volume of users now involved in social media. Rowan-Kenyon et al. (2016) believe that social media is having an effect on the culture surrounding post-secondary education, and that developing and integrating it into the higher education environment is important.
Furthermore, Rowan-Kenyon et al. propose that the use of social media also pervades many aspects of post-secondary education environments. The advent of social media has also pushed a movement of expectation from student users familiar with engaging in this style of content. Selwyn, too, discussed how the proliferation of the social media environment is changing student expectations of information exchange.

Selwyn (2012) argues that the immediate significance of social media for higher education is the apparent changing nature of the students who are entering university. In a practical sense, the highly connected, collective, and creative qualities of social media applications are seen to reflect, and to some extent drive, more flexible, fluid, and accelerated ways of being (Selwyn, 2012, p. 2). While Selwyn’s review of the state of influence of social media on higher education is now rapidly becoming an historical perspective, the current climate has not seen an abatement of the rise of influence of the social media phenomenon. Cooke (2017) argued, “social media and networking sites have become increasingly popular as learning and teaching resources in higher education, providing students with increased opportunities for educational engagement” (p. 255). Cooke investigated how students view the incorporation of social media into higher education. This study was conducted with 93 university students. It incorporated a survey of 15 questions that examined student usage of social media, experience of this in an academic environment, it’s impact on their learning and teaching experiences, and impact on motivation and goals. The study concluded that that there was an increasing engagement with social media as an informal learning tool. Cooke also suggested that the inclusion of social media improves the student learning experience as a supplementary learning tool.

Previous research also investigates issues surrounding the use of social media, and how the contextual use of social media can train students to use these spaces professionally (Fenwick, 2016). Social media can be defined as referring to “a wide range of applications enabling users to create, share, comment and discuss digital contents” (Manca & Ranieri, 2016, p. 217). There are some aspects of social media that require consideration in the context of education delivery. Fenwick (2016) argues that while some in higher education
support social media, often the problematic social transactions and the ethical use of the social media environment come under scrutiny. These risks are recognised as being the blurred lines between professional and social conduct, and the implications that such transactions can have (Fenwick, 2016). This is also proposed to have an impact on higher education and the potential for using a social media environment to develop students’ sense of professionalism in these transactions (Fenwick, 2016). These ideas are significant as the design elements of social media are important considerations in the development of design principles for on-demand resources. The identified design elements of social media are summarised by Selwyn (2012), who commented:

This sense of the Internet use now being a participatory and collective activity is reflected in the language used to describe social media applications. Social media use is often described in terms of collaboration, conviviality and creativity. Social media applications are seen to be open rather than closed, bottom up rather than top down. Social media users go on-line to share and rate, mash-up and remix, friend and trend. (p. 1)

This means that interaction, information exchange, personalisation, and user-guided content contribute to the development of on-demand resources. Draper (2008) discusses how the networks cultivated through “web 2.0” (p. 137) are highly relevant to fostering learning, particularly in the creative industries. He argues that information exchanged through the social media “has enabled a participatory culture which is transforming value systems, undermining notions of authority, and creating rhizomatic pathways for autonomous innovation” (p. 137). Draper’s research recommends that music technology education should facilitate networked information exchange rather than maintaining existing university “information delivery tools” (p. 138). Through incorporating elements of social media design into on-demand learning resource environments, engaging learning tools could evolve. Social media can be Social media design has significant principles that can contribute to on-demand resource design.
2.15 Literature Review Summary

The literature reviewed supports the notion that on-demand learning resources could potentially assist with supporting the learning of popular music production. Popular music education fosters informal learning in a formal education environment (Lebler, 2007). Supporting learning through the provision of on-demand resources is relevant to this environment, where the focus is on facilitating learning. Engaging with popular music production relies on the use of a wide range of music technology. Research into the development of music technology education suggests that over recent decades formal education in the field has become more common, though the development of pedagogical approaches has been challenging (Boehm, 2007). There are links between the self-directed pedagogy employed in the BPM program and the learning approach of musicians using music technology. Outside of formal education environments, self-directed learning while using music technology is often facilitated through on-line learning environments (A. Bell, 2014), which provide information and tutorials to support the users of music technology (i.e., for example, Universal Audio’s website).

It has also been recognised that musicians often use these resources in the process of creating music, and the learning and creating are both part of the process of popular music production (Slater, 2016). This information was used to formulate the proposal that on-demand resource support for largely self-directed musicians could be beneficial, because provision of on-demand resources has the potential to complement the natural learning process of these musicians. Supporting students using these music technologies with on-demand resources could be beneficial on a number of levels. Providing resources in this way assists with their workflow by supporting their popular music production activities. Through embracing this style of learning, formal educators scaffold students in the development of self-directed learning skills, which are utilised by professionals outside of the education environment.

There are broader trends that also support this assertion. Some researchers acknowledge that integrating technology into music education is highly relevant to the
working methods of the contemporary musician (Draper, 2007). This is because of the prevalence of the ways that musicians use technology to create, distribute and learn (Cayari, 2018; Draper, 2007; Waldron, 2013a, 2013b, 2016). There are also suggestions that more on-demand learning opportunities need to be incorporated into post-secondary education generally (Adams Becker et al., 2017). This situation has come about because of the widespread availability of technology and the impact this has had on information exchange for society (Tozman, 2012). These developments have been enabled by mobile learning technologies, which allow information to be accessed while on the move (Mundie & Hooper, 2014). Access to information has led to the development of a knowledge society (Wessels, Finn, Wadhwa & Sveinsdottir, 2017). The development of a knowledge society has implications for post-secondary education, because of the socially constructed knowledge accessible through technology (Laurillard, 2002; Ricaurte, 2016). Networked learning has been influenced by the pervasive spread of technology, which has enabled broader networking capability for individuals (Rainie & Wellman, 2012). This has been the subject of research in the area of music education, where communities of practice have grown to develop practitioners (Cayari, 2018; Waldron, 2013a, 2013b).

There are other more localised reasons why on-demand support within facilities teaching popular music production is relevant. Outside of education there are many existing resources to support music technology in the on-line environment. However, using recording studios often involve configuring multiple pieces of equipment to function together. Information of this nature is not readily available through an on-line search. Contextualised information regarding recording studio spaces could provide information necessary for working within these environments. On-demand resource support in the form of tutorials and other contextualised information could be beneficial. The nature of the support required to facilitate popular music production also relates to technical training. In the corporate world, on-demand training has been enabled by a specific, focused training initiative referred to as JIT training (Draper, 2007). This form of training provides solutions that allow the learner to engage with learning that facilitates the right information, at the right time, and with the right
depth. Experiential learning theory advocates that learning is a process, which should actively incorporate “experiencing, reflecting, thinking and acting” (Kolb & Kolb, 2008). Incorporating on-demand resources could assist with allowing students to engage in learning processes that are natural to their working methods as musicians. The research covered through this literature review also highlighted the design principles that are relevant to the development of on-demand resources through the area of mobile learning (Lecheler & Hosack, 2014). The development of on-demand resources needs to take into consideration the immediacy of the knowledge required and design learning opportunities appropriately.

Throughout the literature reviewed there were indications of the potential role that on-demand resources could play in educative provisioning in popular music production. The literature informed the research process through suggesting how important the student perspective was to the development of design principles. A recurring theme indicated that the self-directed, informal nature of using these learning tools meant that functionality was the key to effective on-demand resource design. The user perspective was the most valuable to inform the development of these principles. This perspective was supplemented with that of education professionals and combined with research identifying existing principles of mobile learning design. The research covered also builds the argument that there is a demonstrated demand for learning tools that engage with the informal learning approach of these musicians. There is a gap in the literature, with no studies delivering the design principles of on-demand resource support for education in the area of popular music production. This thesis will fill this gap through developing these design principles through research conducted within an Australian conservatorium teaching skills in popular music production.
Methodology and Research Method

3.1 Introduction

Design-based research was chosen as the methodology to conduct the research. The study employs data collected from surveys and focus groups to develop design principles for developing on-demand learning resources. Design-based research is an emerging approach to education research, which focuses on the development and review of pedagogical approaches (The Design-Based Research Collective, 2003). Originally used as a methodology within science and engineering, it has emerged to be particularly suitable for research investigating technology-enhanced learning environments (Amiel & Reeves, 2008; Kucirkova, 2016; Wang & Hannafin, 2005). Design-based research was chosen as the methodology for this study over other methodologies, because of its distinct focus on the development of pedagogical design principles. This was further evidenced by the particular relevance of design-based research for research in the area of learning technologies.

Predominantly, the approach is to examine an identified educational problem, define the pedagogy required to address that problem through cycles of theory and practice refinement, and then create a learning environment to support the educational outcome (Anderson & Shattuck, 2012; Joseph, 2004). The methodology incorporates a further process of refinement through systematic evaluation of research. Iterative evaluation of the research works towards further improvement or enhancement of the pedagogy (Anderson & Shattuck, 2012; Kennedy-Clark, 2013). The outcomes of the educational intervention are then used to formulate new theories of learning and teaching, as appropriate to the area (Joseph, 2004; Kennedy-Clark, 2013).

The use of multiple iterations of research through the development, testing, and refinement of design principles has been argued to have benefit for technologically enabled
education research (Wang & Hannafin, 2005). Wang and Hannafin (2005) suggested “using a combination of methods, data from multiple sources increase the objectivity, validity, and applicability of the ongoing research” (p. 10). One of the aspects of design-based research is the shared partnership in the research process by “researchers and practitioners” (Anderson & Shattuck, 2012, p. 17).

The practitioners situated in this research are students and academic teaching staff operating music technology to engage with popular music production within the Bachelor of Popular Music (BPM) program. The integration of a variety of viewpoints can be particularly relevant to design-based research conducted on technology-enhanced learning environments (Amiel & Reeves, 2008; Wang & Hannafin, 2005). Other reasons for choosing design-based research were also considered. The focus of design-based research is the development of design principles, which aligns with the research question of this thesis. Design-based research also fitted the context of the study particularly well, providing a strong methodological base for the study. The viewpoints of technology experts, subject area experts, students, facilitators, and administrators can all be incorporated into advancing design principles through design-based research (Amiel & Reeves, 2008; Wang & Hannafin, 2005). These viewpoints have also been incorporated into this project through the involvement of industry experts, academic staff, and students, and through the development of an on-demand environment for testing these design principles.

There are potential challenges for implementing design-based research as a methodology. One of these challenges is incorporating the multiple iterations of the research cycle because of limitations on resources and researchers (Anderson & Shattuck, 2012; Kennedy-Clark, 2013). This can also be relevant to educational interventions utilising technology, because of the need for funding to continue the work.
3.2 Research Questions

This research project has an overarching research question with a set of underpinning research sub-questions (see Table 1). Table 1 provides an overview of the research questions and the methods being used to investigate them. The overarching research question is:

What design principles should be employed in delivering on-demand resources to support students learning popular music production?

This project is seeking to identify design principles to inform the development and refinements of these learning tools into the future. This research question is supported by three sub-questions that investigate different aspects of the research question:

1. In what ways can on-demand resources be delivered to students learning skills in popular music production?
2. In what ways are on-demand resources being utilised by students learning popular music production?
3. In what ways can on-demand resources be structured to deliver instruction in popular music production?
Table 1. Matrix of Research Questions, Methods and Analysis

<table>
<thead>
<tr>
<th>Research Question</th>
<th>Method of Data Collection</th>
<th>Method of Data Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>In what ways are on-demand resources being utilised by students learning popular music production?</td>
<td>Student Surveys</td>
<td>Univariate and Bivariate Data Analysis Thematic Analysis</td>
</tr>
<tr>
<td></td>
<td>Student Focus Group</td>
<td>Thematic Analysis</td>
</tr>
<tr>
<td>In what ways can on-demand resources be structured to deliver instruction in popular music production?</td>
<td>Student Surveys</td>
<td>Univariate and Bivariate Data Analysis Thematic Analysis</td>
</tr>
<tr>
<td></td>
<td>Student Focus Group</td>
<td>Thematic Analysis</td>
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<tr>
<td></td>
<td>Staff Interviews</td>
<td>Thematic Analysis</td>
</tr>
<tr>
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<td>Thematic Analysis</td>
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<tr>
<td></td>
<td>Staff Interviews</td>
<td>Thematic Analysis</td>
</tr>
</tbody>
</table>

3.3 Design-Based Research as a Framework

Design-Based Research aligns both as a framework for the research conducted within this project and as a framework for the evaluation of on-demand resources to identify design principles for educative provisioning in popular music production. A growing number of studies have made use of design-based research as a methodology for inquiry into the area of
technologically enabled learning (Harrison & West, 2014; Kennedy-Clark, 2013; Parmaxi & Zaphiris, 2015). Anderson and Shattuck (2012) identified six best practice criteria that should be considered when applying design-based research as an educational research methodology. These six principles align with the context of the research project within the BPM program (see Table 2).

Table 2. Alignment of Design-based Research Principles

<table>
<thead>
<tr>
<th>Best Practice for Design-Based Research (Anderson &amp; Shattuck, 2012)</th>
<th>Alignment with BPM Research Context</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. The research is situated in a real educational context.</td>
<td>The research is situated within an education institution and conducted with students involved in the BPM program at the Queensland Conservatorium Griffith University's Gold Coast Campus.</td>
</tr>
<tr>
<td>2. The research focuses on the design and testing of a significant intervention.</td>
<td>Limited formal on-demand support for music technology existed prior to this intervention. This made the intervention a significant shift in the available support mechanisms for students learning popular music production.</td>
</tr>
<tr>
<td>3. The research uses mixed methods.</td>
<td>Information is gathered using mixed methods through surveys and focus groups with students. Interviews are also conducted with staff to provide the view of course facilitators, who are also experts in their respective fields.</td>
</tr>
<tr>
<td>4. The research involves multiple iterations.</td>
<td>The project was conducted using multiple iterations and commenced with a pilot study during 2015, with further testing of the design principles during 2016 and 2017.</td>
</tr>
<tr>
<td>5. The research involves collaboration between researchers and practitioners.</td>
<td>Consultation between staff and students relating to the development of the on-demand resources is a high priority for the project. Staff and student perspectives were incorporated into the research methods and the final development of design principles.</td>
</tr>
<tr>
<td>6. The research evolves design principles.</td>
<td>The primary aim of the project is to develop design principles for evolving technologically shared resources to support students learning popular music production</td>
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</table>

The next section will present an overview of the theoretical perspective of the research. It will then present an overview of the research methods employed during the study, the stages that the study moved through, as well as the data-collection and analysis methods.
3.4 Overview of Theoretical Perspective

The theoretical perspectives of objectivist and subjectivist research provide the basis of many forms of research. Objectivist aligns with the quantitative research methodology and subjectivist with the qualitative one. Within the field of education, research is underpinned by these two paradigms, which have developed with conflicting ideas (Gage, 1989). Contrasting philosophical perspectives about the nature of society and how research should be approached drive this conflict. While modernist thinking views society as a predictable state, post-modernist theorists view society as being in a constant state of flux (Holden & Lynch, 2004). This has had a major philosophical impact on what form research should take (Holden & Lynch, 2004). Despite the polarised views on the topic, mixed methods are also often employed to conduct education research depending on the suitability of the topic (Cresswell, 2008). One of the best-practice criteria for design-based research suggested by Anderson and Shattuck (2012) is the use of a mixed-methods approach to conduct the research. It has been argued that quality research is the result of a combination of solid procedures, aims, and results that are beneficial to the wellbeing of people (Hostetler, 2005). It has also been recognised that quality research should be concerned with how the results of the research will be used, and what understanding will be gained from the results of the research (Hostetler, 2005). Based on these ideals, design-based research offers a solid procedural base to guide the research process when using a number of specific research methods (Anderson & Shattuck, 2012; P. Bell, 2004; Joseph, 2004).

Design-based research provides a strong focus on the design process, with the intention to deliver new pedagogical approaches (Anderson & Shattuck, 2012; Joseph, 2004). Situating the research in an authentic context demonstrates that researchers using design-based research are motivated to provide improved outcomes for students. These motivations align with the context of this research project, where the goal is to develop design principles that assist with the development of effective on-demand pedagogical support for students engaged in popular music production. Through providing a solid
procedural base for conducting the research, design-based research will deliver results in this context.

3.5 Design-Based Research Methods

Typically, design-based research uses mixed methods to conduct inquiry (Anderson & Shattuck, 2012). In the social sciences the use of mixed methods has become a common methodological approach (Bryman, 2012; Cresswell, 2008). It has previously been recognised that the paradigms of objectivist and subjectivist methodologies have been deemed incompatible, though overlap does exist between them (Bryman, 2012; Gay & Airasian, 2003). While debate has continued over the opposing methodologies, a shift towards combining the approaches of quantitative and qualitative research is also being strongly argued (Onwuegbuzie & Leech, 2005; Sale, Lohfeld, & Brazil, 2002). This has seen the use of mixed methods increasingly being viewed as an acceptable method of delivering quality research, particularly in the social sciences (Bryman, 2012; Creswell, 2008).

The use of mixed methods offers a comprehensive overview of the design principles to be considered for supporting student learning in popular music production. It does this through delivering multiple perspectives on the research questions. Because the research is situated in a higher education institution, there are many perspectives that can be drawn upon through the use of a mixed-methods approach. Student surveys provided a snapshot of attitudes surrounding the research questions. This was combined with the in-depth perspective on the design principles of on-demand learning resources elicited through student focus groups. Staff interviews contributed to the development of design principles for the research project, with staff involved in these interviews coming from a variety of backgrounds. While all staff interview participants have been involved in teaching within the BPM program, these staff also had an extensive history of involvement in the music industry. The combination of these perspectives should contribute to the development of an objective study through incorporating multiple perspectives on the research questions. Wang and Hannafin (2005) suggested: “using a combination of methods, data from multiple sources increase the objectivity, validity, and applicability of the ongoing research” (p. 10).
The use of mixed methods in a design-based research framework has the potential to realise the aims of the research.

Design-based research uses multiple iterations to adapt and reflect on the pedagogical interventions used in the research (Anderson & Shattuck, 2012) and is regarded as a useful methodology for research surrounding “technology enhanced learning environments” (Wang & Hannafin, 2005, p. 5). The advantages of using multiple iterations for research into this area include the development, testing, and refinement of principles in an evolving area (Wang & Hannafin, 2005). However, one of the challenges of design-based research is incorporating the multiple iterations of the research cycle because of limitations on resources and researchers (Anderson & Shattuck, 2012; Kennedy-Clark, 2013). Consequently, one of the limitations of this methodology is that it is dependent on the continued support of the leadership and staff at the Queensland Conservatorium. The support for this project was favourable, with overall support for the expansion of blended and on-line models of education existing within the university.

Some limitations of design-based research have been anticipated, which is an important consideration for the development of a robust research design. Design-based research needs to account for “objectivity, reliability and validity” throughout the course of the project (The Design-Based Research Collective, 2003, p. 7). Researchers in the area often have to act as the “advocate and critic” and this can present challenges for remaining objective (The Design-Based Research Collective, 2003, p. 7). Barab and Squire (2004) also suggest this by asking, “What counts as reasonable and useful warrants for advancing assertions investigated through this type of research?” (p. 3). This criticism is a recurring one in the area, but one that should be counteracted through effective research design. The Design-Based Research Collective (2003) suggest that one way of doing this is through structuring the research design in such a way that it “triangulates multiple sources and kinds of data to connect intended and unintended outcomes to processes of enactment” (p. 7). Lincoln and Guba (1985) argued that the validity of research in the social sciences could be
measured by the trustworthiness of the study. They suggest four criteria can be used as a measure of the trustworthiness of the research.

1. Credibility: which is a measure of how believable the findings are.
2. Transferability: how transferable are the findings to other contexts.
3. Dependability: are the findings applicable at other times.
4. Confirmability: to what extent has the researcher’s opinions intruded on the findings.

These criteria are used to measure the trustworthiness of this research. Although this research project uses mixed methods, the study itself is aligned with qualitative social research. It has been argued that social research should be measured with different standards from those of quantitative researchers (Bryman, 2012). The credibility of the study can be interpreted through the resulting design principles, many of which aligned with other literature. The transferability of the study demonstrated that it could be applicable to other contexts of music education. This was also reiterated through the literature. The dependability of the study is time and place dependent. The shifting focus of technology means that these design principles may become irrelevant as technology changes. The bias of the writer as a member of this community could never be completely eliminated, but all reasonable effort was made to remain impartial during the research.

In this research, triangulating the data from student surveys, student focus groups and academic staff interviews allowed a pragmatic approach to delivering the research outcomes. These perspectives were then refined into design principles to form the basis of the project before moving into the subsequent iterations. The credibility of this study can be measured through the finding’s applicability to the design of on-demand learning outside of formal education environments. During the research design process surveys were created, and then shared with academic supervisors to ensure the design of the surveys were appropriate to facilitate the aims of the study. The outcomes of the pilot study were also shared with academic staff during a seminar, where they were given an opportunity to validate the data collected.
3.6 Research Participants

The participants in this research are students and academic staff involved in the Bachelor of Popular Music (BPM), which is delivered on the Gold Coast campus of the Queensland Conservatorium- Griffith University. This involves approximately 120 students and fifteen staff members, working in a purpose-built facility of recording studios and post-production facilities. Throughout the BPM program structure the major study course Popular Music Production is core to all student activities. Students participate in this course each semester, with the courses Popular Music Production 1-6 forming their major study component of the program. Throughout these courses, BPM students use recording studios and music technology to develop portfolio recordings of original material. The research process was conducted over 3 years and involved as wide a range of participants as possible to gain multiple perspectives on the topic. Participation in the research was open to all year levels of the program (1st, 2nd, 3rd year and honours), because the aim of the research was to develop design principles for learning resources to assist students at all stages of the degree program. A number of BPM students from across all year levels of the program participated through surveys that were conducted to gauge a range of student impressions on the subject. Twenty-nine students participated in survey one, forty-four participated in survey two and thirty-six students participated in survey three. Eight academic staff also participated in the research process. These staff participated in formal interviews in which they were asked a series of questions regarding their impressions on the topic of on-demand learning.

3.7 Stages of the Research Project

The research project evolved through five stages to enact the research as detailed in Table 3. The first stage of the project began with the development of a research plan. During this stage the project structure was conceived, and planning for the development of on-demand resources took place. Stage 2 of the project involved conducting a pilot study where on-demand resources were developed and shared with BPM students. There were two surveys and one focus group conducted with the BPM students, while interviews were
THE DESIGN PRINCIPLES OF ON-DEMAND LEARNING:
A DESIGN-BASED RESEARCH STUDY OF EDUCATIVE PROVISIONING IN POPULAR MUSIC PRODUCTION

conducted with eight academic staff. Research during this stage of the project developed some initial design principles through gathering data on the student and staff perspectives on the resources used to support learning in popular music production.

Stage 3 of the project refined the design of the on-demand resources based on the initial design principles established during the pilot study. In response to these design principles the mobile phone application -- BPM Studios -- was developed to distribute the on-demand information. After the initial development of the BPM Studios mobile phone application it was shared with the sample group for evaluation. These students were asked to offer their perspective on the design of the application before it was released to the rest of the cohort. Stage 4 of the project involved the release of the refined application design to the BPM students. This stage also involved conducting research with these students to refine the design principles surrounding the mobile application. The final stage of the project involved analysis and evaluation of the project as a whole, including the development of design principles based on the three iterations of the research project. The stages of the project (see Table 3) follow the method suggested by design-based research, which identifies a cycle of design, evaluation, and delivery of technological support initiatives.

Table 3. Stages of the Research Project

<table>
<thead>
<tr>
<th>Stage 1: Project Development</th>
<th>January 2014 to December 2014</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Research Planning</td>
<td></td>
</tr>
<tr>
<td>2. Develop on-demand resources</td>
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</tbody>
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<table>
<thead>
<tr>
<th>Stage 2: Research Iteration 1: Pilot Study</th>
<th>January 2015 to December 2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Conduct pre and post project surveys with BPM cohort</td>
<td></td>
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<tr>
<td>2. Conduct student focus group with ten BPM students</td>
<td></td>
</tr>
<tr>
<td>3. Conduct eight academic staff interviews</td>
<td></td>
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<tr>
<td>4. Evaluation of pilot study data</td>
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3.8 Pilot Study Research

Stage 2 of the project was a pilot study, which ran during 2015 to evaluate student engagement with a range of on-demand resource delivery methods. This research focused on a range of specific initiatives to address the research question and measure the impact of the intervention. This stage was also conducted to evaluate which delivery method was supported by students, to formulate this fundamental design principle.

Within the BPM program there had been some ongoing technical issues surrounding the use of the recording studio, and the majority of these issues occurred with first-year undergraduate students entering the program. During the pilot study a range of basic equipment and music techniques were identified related to this issue. These topics were addressed through the development of video and screen-capture resources shared with the students. The resources were initially deployed to an organisation site developed for the project entitled the Popular Music Studio Resource, which was delivered through the learning management system Blackboard. Other delivery methods were also incorporated into the design. The resource videos were shared using the Apple application IBook. This IBook was made available through download via the organisation site, as well as being placed on the desktop of the studio computers. The resources were also shared via a Facebook page and a YouTube channel to allow students a variety of ways to access the resources (see Figure 1). Networked learning can play a significant role in music education, with many studies identifying the potential of this as a means of augmenting learning (Cayari, 2015; Waldron, 2013a, 2013b, 2016; Waldron, Mantie, Partti & Tobias, 2018). The students within the BPM program engage with each other, staff and alumni through a Facebook page where the on-line and off-line community intersect. Providing access to the
on-demand resources through social media could provide further opportunities to interact and discuss issues surrounding music technology.

Figure 1. On-demand resource delivery.

3.9 Data-Collection Methods

Three methods of data collection were used to conduct this research project: surveys, focus groups, and interviews (see Figure 2). Surveys are often used in education research to describe trends and identify attitudes (Bryman, 2012; Creswell, 2008). The surveys for this project were designed to gauge student engagement with utilising the on-demand resources, and to further the development of the delivery methods and content. They were created by myself as the researcher and evaluated by my academic supervisors to increase reliability. They focused on how the students utilised the resources and on what improvements could be made to the structure of on-demand resources to maximise student engagement. These surveys used Likert scales to measure attitudinal responses, and included some open questions regarding the resource project since open-ended questions allow researchers to let the participant guide the conversation (Bryman, 2012; Creswell, 2008). In total, three different surveys were conducted with a range of students from across the cohort during the project.

Two surveys were conducted during the pilot study, gathering background information and student impressions on how they saw on-demand education. These surveys were used to
investigate the idea that they would utilise this kind of initiative. The first survey was conducted at the commencement of the pilot study. It was created by myself as the researcher, and asked ten questions to develop some background knowledge of student year level, previous experience with music technology, technical issues they had faced and other relevant background information. The second survey was conducted at the end of the pilot study and asked seven questions. The aim of this survey was to identify student awareness of the on-demand resources, types of information accessed and delivery formats. The first survey was conducted on-line through the learning management system Blackboard. It was open to students from all levels of the program, who were free to participate or decline participation. The second survey was conducted in paper forms. It was also created by myself as the researcher and was open to students within the program and distributed during the assessment period at the end of the semester. Students were given the option to participate if they were interested. Both of these surveys used yes/no responses and Likert scales.

The third survey was conducted at the conclusion of the project with students from across the program. It was done as a paper based survey and students were all offered the opportunity to participate if they were interested in offering an opinion on the on-demand resources. This survey used five questions in total. Two questions were open questions, two were likert scales and two yes/no questions.

Data collected from the surveys were analysed using both bivariate and univariate data analysis techniques where appropriate. Univariate analysis presented an overview of the central tendencies, dispersion, and frequency distribution related to student usage of the resources, and student attitudes to how the on-demand resources were structured. Information related to these research questions was also analysed using bivariate analysis, with the results analysed to identify relevant trends. This analysis explained relationships between the student’s year level and their attitude regarding on-demand resource delivery.

Focus groups were also conducted during the research project. The first focus group, conducted during the pilot study, was convened via social media in a semi-structured way
THE DESIGN PRINCIPLES OF ON-DEMAND LEARNING:
A DESIGN-BASED RESEARCH STUDY OF EDUCATIVE PROVISIONING IN POPULAR MUSIC PRODUCTION
through the creation of a Facebook group. This focus group was asynchronous and conducted over a period of two weeks, with students commenting when they had the opportunity to engage with the conversation. Social media is being used increasingly to connect with students and create a sense of community by higher education institutions (Davis III, Deil-Amen, Rios-Aguilar, & Gonzalez Canche, 2012). This Facebook group was used to facilitate an informal discussion about the project, with questions posted and 10 participants then asked to contribute their opinions on the subject. The use of a focus group allowed the participants to drive the discussion using both structured and semi-structured questions, with the semi-structured questions allowing the participants more flexibility to guide the topics.

There is a high level of interaction between alumni, current students, and staff within the program through social media, making it a fertile space to engage the participants in discussion surrounding the project. Considerations regarding the sample of students invited to participate in the focus group interviews were relevant to ensuring the credibility of the research. This meant that having representatives from the various year levels of the program was a fundamental consideration, because design considerations could differ based on the specific needs of each group. One method that is commonly used in qualitative research for selecting research samples is purposive sampling. This sampling technique allows the researcher to choose participants with relevance to the research questions to be answered, while ensuring that key characteristics are varied enough to gain different perspectives (Bryman, 2012; Creswell, 2008). This research project required an even spread of participants, with specific characteristics related to the cohort. Because of the time and budget restraints of the research project, a purposive sample of 10 students were asked to take part in the focus group. Representative characteristics of all of the recognised groups were considered while choosing the potential pool of participants. This method of sampling aligns strongly with the aims of the research, because it delivered a sample from a cross section of perspectives. For the purpose of this study an even representation of students from each year level of the BPM program were invited to participate in the research. The pilot
study focus group was conducted at the conclusion of that stage of the project to assist with the development of initial design principles for delivering these resources. Ethics approval was sought and granted to conduct the focus group through the Facebook site. Participants were free to withdraw from the focus group at any time and no participants were directly identified during the research, as it was conducted as a closed group, with only participants and researchers involved. The data collected from this focus group was collated as text and thematically analysed to identify recurring themes.

Other focus groups were conducted throughout the research project. A focus group was conducted to evaluate the initial design of the BPM Studios mobile phone application. This focus group provided feedback on the design elements of the application before it was released to the student cohort. This focus group was open to all interested students within the program, and was conducted face-to-face with the four participants who volunteered to participate. The audio recordings of the focus group were transcribed and thematically analysed. A final focus group was conducted at the conclusion of the project. This focus group discussed usage of the mobile application after it had been in use by the student cohort for one teaching period. This final focus group was conducted with four students in face-to-face mode and the audio recording transcribed and thematically analysed.

This research used thematic analysis as a methodological basis for the analysis of the qualitative data collected through the online focus groups. Thematic analysis is a framework for the analysis of qualitative data through the identification of themes and sub themes emerging from research (Bryman, 2012; Denzin & Lincoln, 2005; Gay & Airasian, 2003). In this case the thematic analysis was conducted of the group conversations gathered through Facebook. The analysis then developed a matrix through the identification of core recurring themes occurring during the focus groups. These data were then used to represent the sub themes emerging from the research. The thematic analysis represented a detailed student perspective allowing for the development of design principles for delivering on-demand resources.
Interviews were conducted with eight Queensland Conservatorium staff members to gain their perspective of on-demand education, and how they saw this area emerging. Interviews are a rich source of data for qualitative research (Bryman, 2012; Creswell, 2008). These interviews specifically sought staff members’ perspectives on the effectiveness and role of on-demand education, the design principles they felt should be incorporated in this area, and the characteristics and technology education requirements of popular music students. The interviews were conducted towards the end of the pilot study to assist with the further development of the resources and to provide a background perspective on the student cohort. These interviews were conducted in person, with the interview recorded for the purpose of later transcription. The researcher was a colleague of the academic staff members. Ethics approval was sought for the interviews, with the anonymity or participants provided and informed consent granted by the participants. Coding and thematic analysis are common methods for analysing interview data (Bryman, 2012; Creswell, 2008; Denzin & Lincoln, 2005) and all of the interviews conducted with staff were coded using thematic analysis to identify recurring themes. This was used to lead to the development of the design principles for delivering and creating on-demand resources.

Figure 2. The research methods employed across three iterations of the study.
3.10 Design Iterations

Once initial design principles were established through the pilot study, the resources were refined and developed to allow further testing with the students. During this stage of the project, the emphasis shifted to delivery methods, as many content- and format-related design principles had already emerged from the pilot study. The creation of a Facebook page for sharing technical information was a primary focus, as was the development of refined iBook content and other applicable resource video content. A mobile phone application for linking the content from the YouTube channel and the Facebook page to a centralised mobile access point was also developed and delivered. Following the delivery of these learning resources more research was conducted with the student cohort. Students were given the opportunity to participate in a focus group to evaluate the initial design of the mobile phone application. This focus group was used to evaluate and refine the initial design before it was released to the cohort. The focus group was conducted in person with six students, two from each year level of the program. These focus groups were recorded, transcribed, and coded using thematic analysis (Bryman, 2012) to refine the design principles related to the mobile phone application.

The mobile phone application was then released to the Apple iTunes and Google Play stores to allow it to be downloaded by BPM students, and was promoted to the student cohort during the first teaching period of 2017. At the conclusion of the teaching period another focus group was convened with students from across the BPM program. This focus group was open to students from all year levels to assess the impact of the application, and further refine the design principles behind this learning tool. The focus group was once again recorded, transcribed, and analysed using thematic analysis. A student survey that included Likert scale questions to measure attitudinal responses and open questions to allow students the opportunity to comment freely on the topic was also conducted with students from across the program. Once again, analysis included univariate data analysis of the attitudinal responses and thematic analysis of the responses to the open questions.
Ethical Considerations

Ethics approval for the conduct of this research was sought and granted during the pilot study stage (QCM/14/14/HREC). This approval was then extended to cover further testing and iterations of the research cycle. The primary considerations were the detailing of informed consent procedures, data storage, the anonymity of participants, and the communication of results/reporting. The initial ethics approval covered conduct of the pilot study focus group through Facebook. Conducting research through online environments has its own set of particular issues that need to be considered (McKee & Porter, 2009). Privacy and the mechanisms for seeking informed consent from the participants of online focus groups also requires consideration, as these can differ from face-to-face research (Bryman, 2012). In this case the focus group was hidden from public view and required informed consent from the participants to take part. This was done to maintain the privacy of the participants and their opinions as much as possible. None of the discussions involved anything of a sensitive nature, but just general discussion regarding the use of the on-demand resources. The participants all agreed to share their ideas, though they would not be identified and were under no obligation to participate in the process. The informed consent was managed through email correspondence, with students agreeing to participate in the research project, and then added to the private group hosted on Facebook. The other focus groups, survey and staff interviews were conducted in person. The interviews and the focus group were recorded using a portable audio recorder and transcribed for analysis. The participants were given information regarding the research and their rights as participants, aligned with ethical procedures. The participants in this aspect of the research were given the option to withdraw from the study at any time and guaranteed they would not be identified in any way as an outcome of the research. These participants all completed informed consent, agreeing to participate in the study. These processes were also followed for the survey participants.

The next chapter of this thesis will cover the pilot study, which was conducted to develop some initial design principles for developing on-demand resource support. The pilot
study was an important stage of the research process, as during this the delivery format was trialled to develop one of the fundamental design principles.
Research Iteration 1: Pilot Study

4.1 Pilot Study Overview

During 2015 a pilot study was conducted to explore initial design principles for on-demand resources to support students learning skills in popular music production. The primary aim of the pilot study was to evaluate delivery modes and affirm subject matter for the development of on-demand resources. This evaluation would provide some fundamental design principles for sharing information with the student cohort. This project focussed on the use of on-demand resources to assist students within the BPM program with learning fundamental skills related to recording studio operation, and to increase their overall knowledge of music production. The pilot study progressed through five phases:

1. Conduct pre and post project surveys with BPM cohort
2. Conduct student focus group with ten BPM students
3. Conduct eight academic staff interviews
4. Evaluation of pilot study data
5. Development of initial design principles

The pilot study included formal interviews with academic staff members delivering the BPM program. These interviews together with the student surveys and focus group were analysed and distilled to establish the preliminary design principles to passage the project towards the next iteration of design principle development.

Fundamental skills shared via the on-demand resources were identified through consultation with academic staff delivering the BPM program. This was combined with anecdotal student discussions regarding aspects of recording studio
operation and music production, with the resources to be created focussing on the
development of a range of learning resources to support BPM students.

The planning identified that resources covering music production techniques,
including microphone selection and placement, mixing techniques, and other relevant
music production fundamentals related to recording studio operation and audio
engineering, would be of benefit to the students. However, it was recognised that there
should also be a strong emphasis on sharing technical information related to the use of
audio equipment and software found in the recording studios. These resources were to
include comprehensive overviews of DAW operation, Pro Tools hardware
configuration, audio patching, and outboard audio equipment operation.

Resources were developed and then delivered to students based on this initial
research planning. The resources were 24 video tutorial presentations and 3 screen-
capture videos created by Queensland Conservatorium staff. In total there were 27
videos created for the project, covering the identified areas which incorporated
overviews of basic recording principles including microphone selection and placement
for recording a range of instruments such as drums, electric, acoustic and bass guitars,
vocals, and general microphone theory. Some tutorials covered an overview of
operation of the Digidesign C24 control surface\(^1\), which included the features and
operational aspects of this central piece of equipment. Other tutorials addressed basic
operation of various pieces of hardware equipment found in the studios including a
range of audio pre-amplifiers and compressors. Tutorials dealing with the configuration
of software and hardware interaction included playback engine settings for Pro Tools’
DAW software and input-output configuration for the Avid hardware\(^2\) used to get audio
signal into this software. Screen-capture video demonstrations covered basic mixing
principles and use of audio plug-ins available in the facility. Other demonstrations

\(^1\) The Digidesign C24 control surface is a tool used to enable audio mixing functionality through
controlling DAW software.
\(^2\) Avid hardware used in the BPM recording studios is the HDX recording system, which
converts analogue audio signal to digital.
included patching audio and running headphone distribution systems in the recording studios.

Sharing of these resources then occurred in multiple ways, which allowed students options for accessing the on-demand information. Jenkins, Ford and Green (2013) discuss the potential of “spreadable media” within the context of participatory culture. This refers to new media environments, which promote the circulation of media through larger communities and networks. This project combined the use of formal and informal environments, seeking to identify the most engaging delivery methods for the cohort. The delivery methods trialled included a YouTube channel created for the project that allowed the video resources to be easily shared and embedded in other media formats. A Blackboard Organisation Site was developed to investigate if students would engage in using the resources through a traditional learning management system. A media-embedded iBook was designed that allowed students to download the resources to their mobile phone, laptop, or tablet. This resource was also made available locally on the studio computers and in the student computer lab. The use of a variety of delivery methods was deliberate and designed to test how students engaged with using the on-demand resources. The school Facebook page (BPM noticeboard) was another means of sharing these resources. The high level of interaction that the school demonstrated by engaging in the use of social media such as the Facebook page was viewed as a potential means of sharing on-demand resources with the group.

4.2 Student Survey One

A survey of ten questions was conducted to gauge student support for the use of on-demand resources to support their project work in the recording studio following the delivery phase of the project. The survey was open to all year levels of study within the BPM program. This was because the generic nature of the research topic was transferrable to all year levels, though the resources were aimed at delivering fundamental concepts at this early stage. The survey primarily sought attitudinal
responses, though one open question was included in the survey. This survey was designed to:

1. Provide background information on the BPM cohort and their previous experience with music technology. This was incorporated to inform the design principles by assessing the level of competency the on-demand support resources were catering to amongst the cohort. Through assessing the intended audience of the resources more effective design principles can be developed.

2. Investigate the perceived frequency at which students experienced technical issues. This was investigated to test the hypothesis that students were experiencing difficulties and required additional support. This question also helped to inform the design principles by assessing the type of on-demand resources required by these students. Technical issues within the BPM student cohort often follow common themes, so if students reported they were having issues, then on-demand resources should incorporate particular types of information.

3. Consider what delivery methods students might feel are valuable or more engaging to them. This fundamental question would assess what delivery methods would be pursued in the subsequent iterations of the research project. This is a fundamental design principle and would inform the format of the on-demand resources to be pursued through the project.

4.3 Student Survey Two

After the resources had been available for the duration of one semester, a second survey was delivered. This survey included five questions and was designed to assess student engagement with the on-demand resources, preferences for the type of information shared, and any potential preferences for the delivery methods used in order to investigate student engagement with the resources to understand usage and inform the development of design principles. This information was supplemented with a
student focus group conducted with a purposive sample of 10 students from across the BPM cohort. The focus group participants were asked a series of questions related to how they felt about their learning in this area, including:

1. Their experience of learning to operate a recording studio. The question specifically asks if they felt it was challenging for them, to inform the research regarding the need for additional support to assist students learning skills in popular music production.

2. When they felt they learned most effectively, whether this was during lecture or project work. Once again this question was asked to test the hypothesis that students were predominantly learning these skills when they were required to operate the recording studios as part of their popular music production.

3. Whether having access to on-demand resources had helped them learn some of the technicalities involved in music technology. This sought explicit connection with the students’ desire to engage with on-demand resource support for their popular music production activities.

4. What they considered relevant to making the on-demand resources more effective. This question sought information to refine the design principles used during the pilot study. It would assist with evolving the design into the next stage of the project.

The anticipated outcomes from the research at this stage of the project were to establish a background to the cohort, as well as to explore whether these students felt incorporating on-demand resources would support their learning in this area. The aim of the pilot study was to establish initial design principles for the development and delivery of on-demand resources to support these students.

4.4 Student Survey One: Response

The first survey used a series of 10 questions with a Likert scale to measure attitudinal responses, and one open question where students could express their own
ideas. In total, 36 students participated in this survey from a potential cohort of 125 students, representing 28.79% of the student cohort. While this response rate is not ideal, all efforts were made to increase the participation rate of the student cohort in this survey. It has been suggested that response rates similar to this have validity within research (Bryman, 2012). The responses that were gathered often exhibited central tendencies that were close in the nature of their response. This survey was conducted early in the teaching period and shortly after the release of the on-demand learning resources. Its major function was to evaluate if the BPM students felt that on-demand resource delivery was relevant to them.

Question one asked: “What year level of the BPM program are you currently enrolled in?” The survey had an even spread of respondents across the three year levels of the undergraduate program, with 39% of students participating in the survey being from first year, 33% from second year, and 28% from third year. Because the resources at this stage of development were largely focused on fundamentals, it was anticipated that engagement would be higher with the first-year cohort, and one of the initial aims of the project was to support first-year students with transitioning into the program through providing additional support in this area.

The second question asked students to rate their prior experience -- from very limited experience through to highly experienced -- with recording studio equipment before involvement in the BPM program; twenty one respondents identified as having very limited or limited prior experience, with twelve of the respondents identifying as having some prior experience (see Figure 3). Some students noted that they had “some experience” in the area prior to entering the program, though through prior experience of working with students in the program it has been recognised their prior experience in this area is in fact limited. The focus of the BPM program is on the development of potential singers/songwriters/musicians, with a smaller number of students fully focussed on learning skills in audio engineering and music production. The students who develop a flair for this area usually develop as they move through the program.
The next question asked students about their experience with technical problems whilst using the studio; thirty of the students surveyed had experienced some form of technical difficulties while using the studios (see Figure 4). This result reiterated the focus on the development of resources to assist students with commonly experienced issues. It also reinforced the need for some form of support to help students through these events.

Figure 4. Technical difficulties experienced by students using the recording studios.

A series of questions then sought information about whether students thought they would use on-demand resources if they were provided. It also asked if they thought this would help them to learn these concepts, and when they thought they might use them.
When asked if the students felt they would use on-demand resources to support them in this area, thirty-one students said that they were either highly likely or likely to do so (see Figure 5).

![Figure 5. Potential student engagement with on-demand resources.](image-url)

The BPM students were also asked if they felt that this approach could be valuable to their learning, to which thirty-three of the respondents either strongly agreed or agreed that the use of on-demand resources would help them to learn to use the recording studio more effectively (see Figure 6). This high response affirmed the hypothesis that student support for the use of on-demand resources would be strong. This was also supported by the response to the next question, which related to the context of student use of on-demand resources.
The survey participants were then asked when they thought they would access the resources; twenty-three of the students participating in the survey indicated that they would use this kind of resource to help them when necessary (see Figure 7). The responses to this series of questions suggested that a considerable number of students agreed that on-demand resources are relevant to their development.
The next question asked students about their preferred methods for the delivery of on-demand resources. This question was asked to inform one of the basic design principles for on-demand resource delivery. A number of delivery methods had been used during the pilot study to assess what students considered would be the most useful and relevant to them. In this question students were given the options of downloading to mobile devices, accessing via social media, through the Blackboard learning management system, and/or via the local computer. Overall, fifteen of the students indicated that a download to their preferred mobile device would be their preferred option with this having the highest response rate, with Facebook and Blackboard displaying similar preferences at nine and seven respectively (see Figure 8).

![Figure 8. Students’ delivery method preferences for on-demand resources.](image)

The majority of students responded that download to laptop or mobile device was the preferred delivery method.

Along with the questions seeking attitudinal responses, an open question was presented to give students the opportunity to guide the conversation. This question
asked, “What sort of resources do you think would be most useful to support you in learning to use the recording studio and music production?” The responses to this question were analysed using thematic analysis, to identify recurring themes (see Appendix A- Pilot Study Thematic Analysis- Table A1). This question was asked to inform some of the initial design principles related to the types of information relevant to the student cohort. There were two main themes that emerged from the thematic analysis. The first theme suggested that students needed support in the area of troubleshooting equipment. One student commented that they would find helpful “information on what to do when settings have been changed, or equipment isn’t working as it usually does”. Another student suggested, “A tutorial on how to troubleshoot for things that aren’t working on the studio, and what you can try to find what’s causing the problem”. The second theme was requests for basic set-up procedures, which detailed studio-specific equipment usage. Suggestions included “tutorial videos and/or PDF documents with basic set-up guides, basic EQ and compressor settings”. Other ideas that were presented included “studio specific information such as creating headphone sends” a common set-up procedure that featured in many of the responses. These responses aligned with some of the development of the initial batch of on-demand support resources. They confirmed that one of the main considerations related to the development of design at this stage was to provide support through the development of troubleshooting and basic set-up resources.

In summary, from this initial survey it was established that there was support among these students for the development of on-demand learning opportunities. There was a recognised need to deliver information that could assist with the information that they needed in situations where they lacked basic skills. Survey responses also affirmed that students in the context of this form of information delivery preferred to use personal technology devices.
4.5 Student Survey Two: Response

The second survey was conducted with the BPM student cohort after the resources had been available for a full teaching period during the pilot study. The purpose of this second survey was to review the project’s progress to date, with specific questions in mind. These questions covered:

1. Whether students were utilising the provided resources. This would support the hypothesis that on-demand resources were relevant to these students.
2. What types of information the students found useful. This information would contribute to the design principles for the next iteration of resource development.
3. What delivery methods students preferred. This would provide valuable feedback on the future delivery mode focus.
4. If students still thought on-demand resources were beneficial for learning recording studio operation. This would also provide valuable information regarding the relevance of the on-demand support strategy.

For this survey there were five questions, which used a Likert scale to measure attitudinal response. Students were asked to identify the year level in which they were enrolled, to allow bivariate analysis of the responses where applicable to the question. Forty-four students participated in the survey altogether across the three years of the undergraduate program from a potential of one-hundred and twenty five, representing 35.19% of the cohort. Once again, there was an even response across the year levels of the program.

Following this, students were asked if they had accessed the on-demand resources during the semester. Engagement with using the resources was the highest amongst the first-year student cohort, with eleven of first-year respondents reporting that they had accessed the resources. However, many of the third-year respondents had not accessed the resources (see Figure 9). Because of the nature of the content created for the pilot
study project it was anticipated that engagement would be stronger with the first-year group, as the pilot study was focussed on supporting these students with their transition into popular music production. Consequently, the on-demand resource tutorials covered concepts and equipment used by this group. The majority of respondents, representing twenty-seven students of the sample, did however access the resources, supporting the relevance of on-demand resources for students learning popular music production.

Figure 9. Student access of on-demand resources by year level.

The next question asked the students if they thought on-demand resources would be beneficial to help them to learn recording studio operation. This was a follow up question to a similar one asked during the survey conducted earlier in the semester. The students were supportive of the idea that resources of this type would be beneficial to them while learning to operate a recording studio, with thirty-eight students responding that they either agreed or strongly agreed with the statement (see Figure 10).
**Figure 10.** Student perceptions of benefit of on-demand resources.

The final survey question asked what information the students found the most useful from the pilot study resources. Students responded that the information on recording techniques was highly relevant to them, though a similar number felt that information on control room equipment was useful (see Figure 11).

**Figure 11.** Relevance to students of types of on-demand information.
4.6 Pilot Study: Student Focus Group

During this iteration BPM students participated in a focus group as a part of the research process. This focus group was conducted on-line through a Facebook closed group with a purposive sample of ten students. The text from these Facebook conversations was copied from Facebook into a document, then thematically analysed to identify recurring themes. The focus group sought to establish an in-depth perspective of students’ experience in learning skills in popular music production and to establish the relevance of on-demand resources in supporting this area. Similarly to the open question where troubleshooting came up consistently as a theme in the students’ responses, the idea of information that supported them with having technical information on demand was once again evident. The focus group initially asked the students how they felt about learning to use a recording studio. Was it challenging? Some students found it to be relatively straightforward, while others highlighted that they felt learning these skills was quite challenging. The experience level of the focus group participants was varied, because they came from different stages of the program. Students can struggle initially to develop their skills, though for some their confidence develops as they move into the second year of the program. This question was included to support the hypothesis that on-demand resources are relevant to students learning skills in popular music production (see Appendix A- Pilot Study Thematic Analysis-Table A2).

One of the focus group participants noted, “In first year it took me a while to get my head wrapped around things. There is a lot of information thrown at you in a short period of time”. Another commented, “I definitely wasn’t confident, or capable coming into the course and it took me a long time to even get the basics down”. Other students thought that while it was initially difficult to pick up a skill, it was not outside of their ability. The participants in this focus group exhibited a wide variety of levels of skill development. This furthers the argument that the development of differentiated on-demand resources could be a relevant design principle for catering to these students.
There are many points of differentiation that can be applied to the BPM cohort, supporting the argument that on-demand resources need to cater for diverse skill levels and focuses.

The next question investigated student perspectives about their learning processes while using a recording studio. It specifically asked if the students felt they learnt the most while in a class lecture or during project work. This question was incorporated into the research to test whether students felt that the majority of their learning came through engaging in the process of popular music production. Responses to this would support the relevance of on-demand resources through demonstrating that while lectures were an opportunity to learn, many students were learning a great deal through applying these concepts during self-directed project work. The responses were split evenly between the two opportunities for learning to operate a studio (see Appendix A- Pilot Study Thematic Analysis- Table A3). The following comment by one of the participants summarised their learning: “I have definitely learned from both but I think I consolidate information better while working on projects because you get to put the knowledge into practice”. Some of the responses also highlighted that on-demand resource support could provide learning opportunities to supplement their learning experience. This reinforces that one of the key design principles is the function of on-demand resources to provide supplementary information. In this respect, on-demand resources cover music technology processes not explicitly delivered during lectures and tutorials. This was commented on during the focus groups.

I have definitely had experiences where I come across issues in my own sessions that hadn’t been covered in class, and I have had to either figure out how to fix them myself, ask people around or through Facebook, or even just work around the issue if it couldn’t be fixed.

The varieties of ways that students were learning were demonstrated in a range of skills. Much of what was shared throughout the focus groups indicated the task-specific and contextual nature of the information that they were seeking. Often the participants
highlighted particular pieces of equipment or popular music production processes that they felt could benefit from on-demand resource support. This was further contextualised through the final focus group question, which asked students directly if they thought that on-demand resources would help them to learn the technical processes involved in recording studio set-up and operation. There was a lot of support from the students involved in the focus group for this form of information sharing and the provision of a supported learning environment. Once again, the theme of troubleshooting and basic equipment configuration came through as a major concern for the students (see Appendix A- Pilot Study Thematic Analysis- Table 7). However, it was the contextual, task-specific, and supplementary themes that emerged from the focus group conversations that were beginning to inform the design principles.

4.7 Summary of Pilot Study Findings

The pilot study sought to establish a starting point for sharing on-demand learning resources with students within the BPM program. The aims of the pilot study were to establish the subject matter that students considered would be most beneficial and the delivery methods they perceived as relevant to them. It did this through conducting the surveys and focus group to collect background information on the BPM students. The various delivery methods were then tested and student attitudes to these delivery methods investigated. The pilot study was the first stage of the iterative cycle of resource development and testing that followed the design-based research methodology model. The pilot study established some background information on the students to inform the development of design principles for on-demand resources, finding that 58.3% of students surveyed have limited or very limited prior experience with recording studio operation on entering the BPM program of study. While some students found learning recording studio operation more challenging than others, generally there was a lot of technical information that could benefit them across the program of study. A lot of these contextual and task-specific ideas were reinforced to
deliver a range of potential areas to cover through on-demand resources. The pilot study also identified that a significant number of students had experienced technical difficulties while learning to use the recording studios. Often these technical difficulties came about because of lack of specific knowledge of studio set-up procedures. This identified task-specific, problematic areas that required additional support. It also identified the nature of supplementary resources that students felt could benefit their development.

The data gathered through the pilot study led to the establishment of initial design principles for sharing on-demand resources with students learning skills in popular music production. The project initially focused on the development of technical skills required by students working through the first year of the program. While the content created during the pilot study focused on supporting the first-year student experience, access to these resources was open to the entire BPM cohort. The participants in the surveys and focus groups came from all year levels of the program. These data was then analysed to develop some student design principles emerging from the research. The three key design principles to be considered are as follows:

3 Task Specific: On-demand resources should be formulated to cover information related to troubleshooting and basic set-up procedures as a fundamental consideration. This is because students have demonstrated that these situations are the ones where they are most likely to engage with using on-demand resources, often related to a range of specific scenarios. This theme developed throughout both the student surveys and the student focus group, where many students indicated that they saw on-demand resources as fulfilling this role in their learning.

4 Mobile Device Compatible: On-demand resources should be made available through mobile devices. Access to the on-demand resources via application

download for mobile phones was to prove to be the future direction of the project. The theme of mobile learning became apparent through student responses to the surveys conducted during the research. During the survey the majority of students felt that downloading to a mobile device was their preferred access mode.

5Contextual: On-demand resources need to be applicable to the context of the problem or task. The resources shared during the pilot study were primarily video based, though on-demand resource design should consider the most efficient way of exchanging information. The focus group indicated that they felt that this efficiency of information transfer would speed up response times, allowing them to solve technical issues and then move on with their work.

The next stage of the project was to interview academic staff to seek their perspective on the use of on-demand resources to support students’ learning in popular music production.

4.8 Academic Staff Interviews Overview

Throughout the pilot study, student focus groups and surveys evaluated the student perspective related to on-demand resource delivery. Through this research, some initial design principles for developing on-demand resources were identified. During the pilot study BPM academic staff were also interviewed to gain their insight on the design principles they felt were relevant for delivering on-demand resources. They were also asked questions regarding the relevance of on-demand resources in supporting BPM students to learn skills in popular music production. These interviews formally recognise the perspective of the BPM academic staff as specialists in the areas of music technology and popular music education. The inclusion of the BPM academic staff into the research process has the potential to enrich the outcomes of the research, through incorporating the teacher’s perspective. Design-based research often involves

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collaboration between researchers and participants to develop an authentic picture of the nature of the educational context (The Design-Based Research Collective, 2003). This idea is reiterated by Anderson and Shattuck (2012) who argue that researchers and teachers need to form a partnership “that negotiates the problem from initial problem identification, through literature review, to intervention design and construction, implementation, assessment, and to the creation and publication of theoretical and design principles” (p. 17).

In order to achieve this collaboration, six BPM academic staff agreed to participate in a formal interview process. The six staff members who participated in these interviews were either full-time or sessional academic staff involved in teaching within the program. Five of the interview participants teach within the areas of audio engineering, popular music production, and music programming. Two of the participants have been involved in convening the BPM program. The majority of these academic staff also have extensive music industry experience, having worked as freelance recording engineers, music producers, and musicians before working as academic staff delivering the BPM program. The first participant interviewed teaches music production and has significant industry experience as an audio engineer and music producer. The staff member has worked professionally in this capacity for thirty-two years, having worked with a range of successful musicians and producers both within Australia and internationally. He now works full-time as an academic within the BPM program, and for the purposes of this analysis is being identified during these interviews under the pseudonym Adam. The second participant is a sessional staff member, Cameron, who has a teaching specialisation in the area of music programming coupled with forty years of industry experience in the area and a long history of working in music technology. The next participant, with the pseudonym Lachlan, has a long history of industry experience as a professional musician, having worked professionally within Australia and overseas as a drummer for over fifty years. This participant also has an international profile as an academic in the field of popular music
education. The fourth participant, Wendy, has twenty years of experience in the field of popular music education, having worked within the BPM program since its development. Michael, the fifth participant, is a sessional academic staff member who also currently works in the industry as a freelance audio engineer. He has been heavily involved in teaching audio engineering to the BPM students over twenty years. The final interview participant, called Warren, is a full-time academic staff member, teaching into the areas of introductory sound and popular music production. He also has over fifty years of working in the music industry as a professional musician and educator.

The interviews had a number of areas to investigate, with the questions designed to contribute an academic staff perspective to establishing the relevance of on-demand resources, as well as to the design principles that should be considered when delivering these resources. Initial questions sought to clarify how the academic staff understood the role of on-demand resources, their effectiveness, and whether they are relevant to the needs of BPM students. Following this, the participants were also asked questions relating to the design of on-demand resources. This included conversations about what constituted on-demand resources and what aspects of design they considered important. Other ideas that emerged from the research conducted with the BPM students were also raised, specifically the role that peer learning could play in an on-demand resource environment. The interviews were conducted individually, recorded, and later transcribed for thematic analysis, where emerging themes were identified from the interview transcriptions. The following presentation of questions will also include a discussion, where appropriate to reinforce the validity of the questioning.

4.9 Staff Perspective on BPM Student Characteristics

The first question posed to staff delved into the BPM student characteristics and how the academic staff viewed these students, having worked with many students over their years of involvement with the Queensland Conservatorium. This question had the
potential to inform the relevant design principles through establishing the intended audience for the on-demand resources. Lecheler and Hosack (2014) suggest that understanding the intended audience can assist with developing effective mobile learning design. This is also viewed as an essential design consideration by Banga and Weinhold (2014). In general, the academic staff suggested that there were some obvious differences among the average BPM students’ specialisation and accumulated knowledge prior to entering the program. This theme suggested that the on-demand resources would be catering to a diverse group of musicians who have variable skill levels related to popular music production, meaning that the design of resources needed to cater for this diversity. This was commented on by Adam, who reflected on the different types of students he had encountered through teaching audio production.

So if we were going to categorise them into talent, you'd get singer/songwriters and you'd get DJ type people. You'd get record production/engineering type people. Then if we were to break it down to other levels, we get people who believe their knowledge base is of a high level. Some people who have no knowledge base at all and are very reluctant to engage. (Adam)

This idea was reiterated by Michael who saw students in terms of their focus on using music technology and the various degrees of engagement with this aspect of the program. Michael noted that there was diversity, meaning that from a teacher’s perspective a generalised approach was probably the most relevant.

I mean they're fairly across the board-wide gamut of everything from singer songwriters to producers. They're probably not quite – they're not as specific and have the blinkers on – I'm going to do this necessarily. They do have a little bit of cross interest in the different aspects of music technology, modern music production and modern production – and popular music stuff. So there's no real specific focus on them. That generalised focus is a good thing. I think that sets them - sets this course apart from a lot of other places where it is a little bit more niche focused. (Michael)
Other viewpoints described students and their motivation levels as defining factors of the demographic. A number of academic staff felt that there was no typical BPM student, but rather a diverse group with a range of attributes, with independent learning skills as a factor determining their approach to learning.

I don't think there's a typical BPM student but there are nonetheless several types of students. So you would have the highly motivated student that seeks out knowledge independently who would be very likely to use something like that, as long as they knew it was there with very little input and he probably had been accessing online help anyway, so would be used to that culture. They're the most likely to succeed student because they're very good independent learners and at the other extreme you would have the student who needs their hand to be held the whole time and who maybe would be the least likely to benefit out of on-demand learning because they would require a person to explain something to them, and they're the opposite end of the spectrum. Then in between you have people who are actually more – on a sliding scale, in between those two extremes that would access it to varying degrees. (Wendy)

These perspectives were all examples of the responses of how the academic staff viewed the BPM student characteristics. The other staff members that were interviewed also agreed that the BPM students were a diverse group, with a wide range of skill sets represented. Establishing that there is a diversity of student attributes, focus, and motivation levels is an important consideration during the development of resources. Catering to this diversity was to become a primary design consideration, because on-demand resources need to target appropriate experience levels to be relevant to the audience. In the context of the BPM program this means that the various year levels need to be differentiated to accommodate a variety of skill levels. On-demand resource development also needs to consider the various types of popular music production engaged with by BPM students. Skills relevant to electronic music producers are different from skills required by those working in the realm of rock, pop, or country
genres. Consequently, resource design needs to cater for a range of skills relevant to different genres within popular music production.

4.10 Staff Perspective on the Relevance of On-Demand Resources

The next series of questions sought to determine the BPM academic staff perspectives on the relevance of on-demand resources. BPM students had indicated that they felt that having the support of on-demand resources was relevant to their needs; the BPM academic staff were asked if they felt on-demand resources had a role to play in educating students learning skills in popular music production. Throughout the staff interviews a theme emerged which demonstrated that the BPM academic staff viewed on-demand resources as fundamentally relevant to the needs of BPM students.

I think that their role is to support what has been learnt in the lectures and applied in the tutorials, so it's almost like continuing the role of a tutorial or workshop in that students can look for information just to help them problem solve as they work their way through what they've learnt in class. So it's a continuation of that. (Wendy)

The other five academic staff had a similar view of where these resources fitted within the program, reinforcing this idea. It was also proposed that, “Depending on the subject that it's being integrated with, I'd see on-demand resources to support educational frameworks that were designed within course content” (Adam). The academic staff also recognised on-demand resources as a vehicle for potentially learning whatever you wanted, whenever you needed it, through the broad resources accessible through the World Wide Web. Outside of formal education social media and networked learning in the area of music enable learning in a variety of contexts (Cayari, 2018; Salavuo, 2006, 2008; Waldron, 2013a, 2013b). Some staff felt that this approach to facilitating learning could be curated by the university, or could make use of access to pre-existing resources available on the Internet.
Oh I think they're vital and whether they're – sorry, whether they're created and curated by the university is one thing, but there's this thing called the inter-web, which is – there's a myriad of resources out there that already satisfy that. But I can imagine that if Griffith were actually focused on particular deliverables that were attuned for the course that would be a great and wonderful thing.

(Cameron)

The idea of the on-demand resources supporting learning came through quite strongly, acknowledging that on-demand resources could provide students with the opportunity to revise and refresh content. All of the staff members that participated agreed with this idea. The view that on-demand education’s role is to support traditional education models aligned with current thinking about the way that music education in post-secondary education is structured. Graham et al. (2015) consider that the role of higher education providers is to focus on developing the student experience in a way that aligns the pedagogy with real-world experiences. The BPM pedagogical orientation is on students working together to produce music in a way that mirrors contemporary music industry working methods (Anthony, 2015; Lebler, 2008).

The BPM major study program is pedagogically focussed on the learning experience gathered through project work. While peer networks within BPM occur naturally through student project work, accessing information and networking is possible in a variety of contexts regardless of place (Waldron, 2013a). This is important to the learning process through the sharing of information, which can be enabled through on-line or off-line environments (Waldron, Mantie, Partti & Tobias, 2018). On-demand resources fall naturally into a supporting role, through providing access to information and supporting networks. Access to on-demand resources allow students to apply real-world skills in popular music production through active learning experiences.

The next question was posed to detail the academic staff’s thoughts about on-demand resources as effective learning tools for students in the area of popular music production. Some studies have been conducted into the use of resources to assist
students to navigate technical equipment, but work around this area is limited at this stage (King, 2009a). BPM academic staff teaching recording studio operation, audio engineering, and music production prefer traditional face-to-face delivery methods rather than a blended learning approach to teaching. This is relatively common in higher education, as often delivery methods fall out of step with newly available technologies (Kode Sutton & DeSantis, 2016). It is also possible that the academic staff members did not feel that on-demand education is effective for teaching students about these concepts; therefore, it was important to ascertain whether these staff members felt on-demand resources had value or not. During the interviews, all six academic staff suggested on-demand education to be an effective and necessary part of any contemporary education system.

I think they are an important reinforcement of learning tools, but also can be used to enhance learning in other ways. Like in learning new – like new material. Yeah but again it's always contextualised in what they're learning at the time in my opinion. (Wendy)

Lachlan reiterated this idea, suggesting that on-demand education aligned with the learning approach already prevalent amongst the student demographic in general. He also suggested that this was already part of a student’s natural learning environment.

I think they're a necessary pedagogical tool for educating students in the second decade of the 21st century, because that's how they live their lives. I see people are going to YouTube and acquiring incredible abilities very, very quickly and for us to provide those kinds of things for students is kind of like a curatorship. Sometimes we would create them for ourselves, other times we can just identify ones which are already in the public domain and say for further info click this link that kind of deal. (Lachlan)

There was strong support for the use of on-demand information within and outside of a university-curated system. Some concerns were raised about student engagement with using on-demand information. Adam raised the point that disinterested students might
simply just avoid using these, while proactive students would thrive on using whatever information they could access.

I think they're extremely effective if the student isn't lazy. Because you can have as many of these resources for students to access, but you're not actually there making them access the resource. So when they're used, I think they are. (Adam)

The BPM academic staff who participated felt that on-demand education was effective and relevant to teaching students the skills involved in the popular music production. It was noted that it was highly relevant to problem solving related to technology, taking on the role of virtual teacher in times of need.

I think utilising on-demand video is a perfect way to encourage them to tackle those technological problems, particularly when no one's around. We have 24-hour access here. What happens if they run into trouble in patching or something at three o'clock in the morning? As long as they know where to go to see it they can just stream it and not have to give up and leave the studio or be contacting staff after hours or something. (Warren)

This question was followed by asking whether on-demand learning resources should be a key method for educating students, or a supplement to their education. This is relevant to the development of design principles, because on-demand resources can be delivered in a multitude of ways. If they were to be delivered as a primary means of education, then delivery formats could be affected. The pilot study trialled a number of delivery methods to see which formats students engaged with, effectively testing when on-demand learning resources were most relevant to students learning these skills. A theme emerged through the academic staff interviews, which suggested that on-demand resources should be used to supplement the delivery of coursework. However, there was also discussion about how it could also be a key method for educating students, dependant on the context of the delivery method. Wendy reinforced this idea:
I would think as a supplement, like as a learning enhancement or support tool but now that you say that I think given the right tools they could possibly be used as primary teaching tools as well. (Wendy)

Other staff felt strongly about on-demand education taking a supplementary role in educating students, because of the need for learners to engage with each other and the lecturer.

I think as a supplement. I don't think there can be a viable replacement for real time discourse in a classroom still. I still think that's where if you want to evoke a stereotypical phrase, the marketplace of ideas actually happens. But the stuff that is acquired out of there through direction is extremely important, but I don't think it can replace the actual lecture/tutorial model that we've had for a long time now. (Cameron)

Some academic staff members felt on-demand resources could never replace the one-on-one interaction with the equipment that occurs during classes. They felt strongly that the role of on-demand resources was to support learning, because of the lack of human connection. Rainie and Wellman (2012) support these ideas through their suggestion that information and communications technologies will never replace the human element, but will only supplement human interaction.

I think as a supplement. I don't see it today… I still like the one-on-one interaction, the anecdotal stuff. That one-on-one, the feely-touchy, the kinetic sort of connection they have with watching somebody do it, explaining it and to be able to answer questions too and to hear students’ problems. (Warren)

The six academic staff members consensus was that on-demand resources supplemented quite effectively, though the potential for it being a fundamental means of education existed. Within the BPM program some resources for students in this area currently exist, mostly because of the resource development that occurred during the pilot study. This initiative changed some of the ways that students could access technical information within the BPM program. Prior to this, however, the majority of courses
incorporated some form of online resources through the Blackboard framework, but little other formal opportunities. Some discussion revolved around the formal supplementation of coursework using on-demand resources as a blended learning model:

That's the principle, as you'd understand with the flip classroom is you put your sort of small chunks of learning on the web, students engage with that and your interactions with them are based on their applications of that information, not on their acquisition of that information. So the instances of this occur at all levels of education. (Lachlan)

The BPM academic staff were then asked if BPM students needed to develop skills in self-directed learning to assist them with learning in popular music production. The BPM program is based around a structured, self-directed learning environment where students work together on projects to learn skills applicable to the music industry (Anthony, 2015; Lebler, 2008). While the program’s major study requires students to produce portfolios of recorded work, skills in popular music production occur during explicit teaching within the supporting studies stream. However, the limitations of class size and equipment limit the opportunities for students to get hands on with the equipment during these workshops. Often, some students find that the real learning process occurs when they come to actually using the studios. There is also a range of equipment and techniques involved in popular music production that are not explicitly taught during class. Providing students with more opportunities to engage in self-directed learning could be highly relevant to BPM students, therefore demonstrating that providing on-demand resources is relevant to how these students learn. The majority of the academic staff felt that the average BPM student already has skills in self-directed learning, as this is central to the way musicians tend to work outside of formal education environments. This has been the topic of much research outside of the BPM program, which recognises that popular musicians tend to learn informally when left to their own devices (Lebler, 2007). Wendy felt that the development of on-demand
learning strategies was a natural extension of the self-directed learning environment already in place within the BPM program. Delivering on-demand resources to the cohort would encourage students to develop these self-directed learning skills, which ultimately translate into life-long learning skills. Wendy stated:

All those skills are already embedded in all of the BPM courses, so it's only logical that would extend beyond that because this is just another extension of that self-directed learning environment. So it's not separate to what's already there, it's actually just another way of actually encouraging that and you've got all the focus – like, as you know, lifelong learning and all that kind of stuff which is another outcome. (Wendy)

Adam also supported extending self-directed learning opportunities for BPM students. He viewed it as essential that students develop these skills because that was primarily how they tended to learn: “that's the most suitable way of them learning, is them doing and directing their own learning. Because a parrot type teaching fashion just doesn't seem to be anywhere near as effective.” Other academic staff viewed this as a natural extension of the learning environment that students engage with outside of their formal learning. This meant that students already had skills in self-directed learning, but they needed to be given the opportunity to use these skills in their formal education:

I think they already have them. It's just a matter of them being encouraged to utilise them within the academy as opposed to what they do as soon as your back is turned, which is essentially go to their real teacher, which is the online community or the online world. (Lachlan)

Previous research has argued that students can struggle with selecting tasks in self-directed learning environments because of their inexperience in the area (Kicken et al., 2008). Their ability to self-assess has also been viewed as an asset when selecting tasks within a self-directed learning environment (Kostons, Van Gog, & Paas, 2010). While often BPM students are able to navigate the concepts with some degree of competency, there are occasions where their lack of knowledge could mean they may struggle to find
relevant topics or on-demand instruction. The scaffolding of some information could be an important design principle for on-demand learning environments.

The questioning up until this point of the interviews sought to establish the relevance of on-demand resources from an academic staff perspective within the BPM program. The academic staff all displayed a high level of support for the incorporation of on-demand resources. They also considered the presence or support of this form of information delivery as a supplement to educating students about skills in popular music production was important. The BPM academic staff also felt that they were effective for helping students to revise concepts, and to learn at their own pace. The next series of questions sought to aid in the further identification of design principles, through asking specifically what design principles the academic staff thought would be effective; this included aspects of popular music production they considered would benefit from this support.

The next question investigated what BPM academic staff understood on-demand resources to be. The question sought to decipher what the academic staff thought constituted this style of learning resource. Through establishing a shared definition, it sought to find whether there was consensus on the topic, or whether there were differences of opinion regarding the definition. It was also anticipated that the responses would refine, from a fundamental design perspective, what constitutes on-demand resources. The academic staff members shared a similar perspective of what this form of education involved. In general, the academic staff agreed that on-demand resources should be readily accessible and streamed in real time as a primary indicator:

My idea of on-demand learning is something that students can access at any time, regardless of whether there is teaching staff, or any other support present. That would usually be online because that's the easiest thing to access. So anything that would support their learning that they can access at any time.

(Wendy)
Other prominent themes emerging from the interviews involved the personalised nature of on-demand learning, and the idea that these resources were a support mechanism for furthering or reinforcing student knowledge and skills when the student felt the need or desire to engage with the subject matter. Lachlan commented that on-demand resources constituted “resources that students can access – well, firstly resources that relate directly to what it is that the student is intending to learn about.” Some staff suggested there were multiple roles for on-demand resources in educating students including for immediate troubleshooting as well as extending individual long-term learning goals:

Well, on-demand for me means basically anything that you can access any time and students could access any time. So the immediacy is good for – I guess problem solving would probably be the first and foremost issue that people would go to those for, I would think, if they're in a certain situation and then need to find a solution to why something is not working or how they could fix a problem. Then I guess secondary would be the longer term learning – I want to know how to do this for next time type situation and their ongoing learning investment. (Michael)

The function of this question was to establish if the academic staff members viewed on-demand resources similarly, before other lines of questioning began. It was evident that there was a consensus that demonstrated the idea of on-demand education was similar across the BPM academic staff interviewed. There was no discussion of specific modes of delivery during these conversations, with the primary focus on the general nature of the delivery method.

4.11 Academic Staff Design Considerations

The next question asked specifically what design principles the staff members thought would be effective for delivering on-demand resources in this field. A recurring theme in the responses was the incorporation of visual content to engage the learner through demonstration.
I guess it probably comes down to what you're trying to achieve with it. Again from an audio point of view I think the demonstration – demonstrating a process as much as you can like a – almost like a chronological process – is actually really good. Which is why videos work well. When I say videos it's probably more of a screen capture with a narration. (Michael)

Other staff members, who proposed that method was probably the most efficient way of trying to support education in popular music production, reinforced this idea. Adam stated:

I think when students can actually see a video and watch someone like myself, or you actually doing it. That's how I learn anything. I go onto Google and I YouTube a video on how to do it. To me, that's probably the most efficient way of trying to educate in music production and engineering. It's not something you can just talk about. You actually have to see it being done or experience doing it to learn. (Adam)

Another academic staff member saw the potential of video demonstrations available via YouTube. The impact and effectiveness of this form of visual information, was something that could be incorporated into teaching.

Everything you want to know about it you can find on YouTube. I see people are going to YouTube and acquiring incredible abilities very, very quickly and for us to provide those kinds of things for students is kind of like a curatorship.

(Lachlan)

Wendy supported the theme of using visual tutorials during her interview. During the interview she discussed how YouTube was the most relevant contemporary on-line learning tool. “YouTube I think is a very good idea as an online on-demand learning tool because that's the go to for this generation at least”.

The next theme identified that resources needed to be logical to enable students to access information easily. One of the academic staff members discussed the importance of a logical and well-structured system during the interviews.
I think it's pretty straightforward. Well planned out in some sort of systematic approach at how to set up a particular item – that it's in step by step, well-paced and it's not too fast for the beginner yet not too laborious for the more advanced students. (Warren)

The other academic staff members, who discussed the need for students to have a logical system to follow, reiterated this theme. This would enable them to find information quickly and easily.

Another theme emerged that suggested that on-demand resources needed to be engaging for a contemporary audience. Lachlan saw it as something that was fluid, but attuned to the audience so that they were more likely to engage with it. That is, it was important to cater to your demographic by making it interesting, exciting and modern in approach. Other academic staff members supported this idea as well.

You can make it as perfunctory as you like, don't worry about the design aesthetic of it and that may well work for particular circumstances or you can take a little bit more trouble and try it make a bit clean, a bit sort of styled and put some energy into that and so you can make the students’ engagement with it feel for them a little less like engaging with an old person's website. So I think that's important. (Lachlan)

The academic staff members were then asked what aspects of popular music production could benefit from this kind of support. Similarly to the responses of the BPM students, the theme of troubleshooting resources came up again quite strongly. The idea of starting with common issues experienced at the start of the program was also an aspect the academic staff felt should be included.

I'm guessing that the most common problems that you run into will be the best things to start with. Fundamental things like starting up a system and making all the components in it see each other properly. So that sort of stuff is actually ideal. The sort of things that you would normally need to deal with in person 20 times a week. (Lachlan)
It was also noted that the on-demand resources would evolve and change over time as the students progressed through the program because of their changing needs. The academic staff all agreed with this theme that suggested that on-demand resources needed to be differentiated. This differentiation would facilitate an evolution that would move from basic principles to more advanced or creative concepts. It was commented that this would work more effectively in the context of the program and related to the students’ year level.

Okay, so the first – I think the main value to begin with is for first year students because they're the ones that are more at risk and have the least experience and the least student support network to actually ask questions of others. So they're the ones who are going to feel a little bit isolated and I imagine that the biggest help would be right at the start, that's actually people with no experience. Things like – I often see, just simple stuff, like just getting signal from one place to another, like really basic stuff where it's something as simple as something has been patched incorrectly or something isn't switched on. So a troubleshooting type guide I think would be – like that would be my first priority but then it depends on the course and on the year level. So, whereas I guess first years the most helpful things for those are going to be very basic, just principles of recording sound. As you get further into years and it becomes more complex there might be – and when more creative choices come into play it would be less nuts and bolts type stuff. (Wendy)

Differentiation also needed to consider the variety of skill levels and the different genre focuses of the students. The idea of expanding content into the more creative areas of music production was particularly important to staff teaching into the areas of creativity and music production.

Yeah. I think it needs to go beyond basic principles. I think it needs to, at some point, cover basic principles, but it needs to help students to progress further than just being educated in what things do and more so how to actually go
about doing it. For example, using the SSL desk in there, or using certain microphones in there. You can be taught how to do it but then more so seeing it in action and when to apply certain techniques et cetera is more appropriate for me. More kind of creative base concepts is where hopefully students could pick something up from that. (Adam)

During the academic staff interviews the importance of peer-assisted learning in online environments was investigated. The importance of relationships with peers during informal online learning activities, had been recognised as significant to BPM students. Other research has also noted the importance of learning communities in supporting musicians to learn (Draper, 2008; Partti & Karlsen, 2010; Waldron, 2009, 2013a, 2013b, 2016, 2018, Waldron, Mantie, Partti & Tobias, 2018). During the pilot study students also noted that they often approached peers to solve their technical issues and to assist them with learning technical concepts and applications. Based on these ideas the potential for incorporating student-driven content as a design principle of on-demand learning resources was considered. The BPM program has conducted research that demonstrates the importance of peer learning within the program (Lebler, 2008). The high level of engagement of students and staff through the school Facebook page (The BPM Noticeboard) has also demonstrated the learning potential that the online community of staff, students, and alumni can facilitate. The responses to this question were quite mixed. Generally, staff saw the value of peer learning, though the majority weren’t sure how this fitted into an on-demand learning environment. This seemed to be because their perception of the project related to sharing videos and information, rather than the design of an environment that encompassed all aspects of learning -- an environment not limited strictly to video content, but one that could incorporate a social media styled environment where peers could interact and learn from each other. This question was met with a general level of support amongst staff.

I think it's probably the most underrated thing with the students. Is that they actually enjoy talking to each other but they don’t realise how much they learn
by working together. I think it's so essential to have students working together
and learning and communicating with each other and promoting their ideas and
making mistakes and moving forward and having conflict in the studio, that if
they didn't have that social contact with other people, then they would stop
progressing as musicians. (Adam)

This idea was also discussed with other staff who saw the value of an integrated system
where resources and on-demand learning opportunities were delivered together as a
comprehensive learning environment.

Yeah, well that's kind of what I was about to tell you anyway, is that you could
actually make a social media page work in with, alongside the on-demand
learning modules, because that would be – and that would be peer learning then.

(Wendy)

Other perspectives saw the opportunity for the spread of misinformation through a peer-
enhanced social media styled environment. Michael commented that the potential for
this was something that needed to be managed, but did not outweigh the benefits of peer
learning that could be facilitated in this sort of environment:

I think peer learning is definitely important because you can learn a lot from
your peers. They inspire you and – especially if you're – again the strength of
this course is you have people that have – not necessarily strong in certain areas
and having great peer relations can help solidify those skills as they develop and
pick things up here and there. It's a great thing. It was always – I thought of a
great thing that happened when I was at uni – learning off your peers. I mean
it's not without its downsides either because you can – it becomes this insular
environment and you can – it's the Chinese whispers thing – the
misinformation. You've got to be a little bit careful. But I think it's still – the
pros outweigh the cons I think for sure. Even in a – from again collaborations
and all that, that stems from it is fantastic, is really, really good. (Michael)
The networking enabled through on-line communities has also been recognised as growing significantly in importance to music learning (Cayari, 2015, 2018; O’Flynn, 2015; Palmquist & Barnes, 2015; Waldron, 2013a, 2013b, 2016, 2018).

4.12 Summary of Academic Staff Interviews

In summarising the staff responses to the interviews, it is noted that most staff saw the appropriate design principles for on-demand resourcing in similar ways. The themes that evolved suggested that on-demand resources needed to be visual, logical, supplementary, differentiated, engaging and student-driven in their approach. Recurrent themes throughout the interviews demonstrated a degree of consistency in the way BPM academic staff view this approach to facilitating learning. The questions were grouped to establish how the academic staff viewed the makeup and role of on-demand learning within the BPM program. The academic staff members also agreed that on-demand resources were relevant for supporting students learning skills in popular music production. The interviews were conducted at the conclusion of the pilot study rollout of resources with students, which gave the academic staff the opportunity to reflect on where this concept could be useful in supporting student learning. It also allowed academic staff the opportunity to contribute to the initial design principles formulated through the pilot study, and they identified a number of design principles that they felt would be effective to consider when developing on-demand resources (see Figure 12). These included:

1. Visual: On-demand resources should focus on visual content, which the staff felt conveyed the information more effectively in most situations. This visual content should take the format of a demonstration, which steps through the task. This theme emerged strongly through the academic staff interviews, with all academic staff reiterating this focus.

2. Logical: On-demand resources should be well structured within the delivery format, logical in their presentation, and easily accessible by the students. The
academic staff felt that this would increase the useability of the on-demand resources.

3. Supplementary: On-demand resources should assist with troubleshooting and provide a supplementary form of learning for the students learning popular music production. That is that the on-demand resources should focus on filling the gaps in student knowledge relating to technical processes.

4. Differentiated: On-demand resources should cater for student diversity by addressing the needs of students at various stages of the program and at various skill levels and genre focus. Through providing differentiation, recognition of these characteristics offers opportunities to support the diversity of the student cohort.

5. Engaging: On-demand resources should exhibit good production values that engage a contemporary audience. On-demand resources need to mirror the standards of resources found outside of formal education environments, through keeping up with emerging trends in the area.

6. Student-driven Content: The influence of peer learning through online environments plus the impact of social media suggest the student-driven content in the form of tutorials or social media styled forums should be considered.
Based on the findings of the pilot study, a series of preliminary design principles were identified. These included:

**Mobile device compatible:** On-demand resources should be delivered via mobile devices. Mobile devices will allow enhanced opportunities for students to engage in on-demand learning. This design principle emerged strongly through the student surveys, where students indicated that they preferred to access information through mobile devices. The nature of on-demand learning also suggested that mobile learning would be the most applicable delivery method, allowing engagement with learning when necessary. Mobile learning is recognised as a personalised learning experience, where individuals can engage in relevant learning experiences (Mundie & Hooper, 2014). The use of mobile learning has practical applications for formal music education, as students often...
prioritise the most accessible technology in their creative activities (Wallerstedt & Hillman, 2015). This design principle is a foundation for this project, having trialled a variety of delivery methods during the pilot study.

**Task-specific:** On-demand resources should focus on providing demonstrations relating to troubleshooting and basic set-up procedures for the skills and music technology involved in popular music production. This design principle emerged through the student surveys, focus groups and academic staff interviews, where it was suggested that the basic nature of on-demand resources would be to provide task-specific information. Mobile learning design principles suggest that information should be structured in a practical way to assist learners with engaging with information while on the move (Gu et al, 2006). This information should also fit into time frames that allow the user time to engage with learning in the available time (Gu et al, 2006). These design principles align with the proposal that resources should be task-specific in their focus.

**Visual:** On-demand resources should use video demonstrations to demonstrate the use of equipment or application of a variety of popular music production techniques. This design principle developed from the academic staff interviews, where it was suggested that visual information had the ability to demonstrate music technology and popular music production techniques in the most engaging way. It is suggested by Lechler & Hosack (2014) that mobile learning design should focus on visuals as a way of conveying information.

**Contextual:** While visual emerged as a design principle, another theme suggested that the context of the on-demand information should be considered and, where appropriate, other forms of information delivery considered. The basis of this design principle is that the most efficient way of conveying information should be chosen. This depends on the context of the information or technique being covered. This design principle emerged through the
focus group conducted with students. Lechler and Hosack (2014) also propose that mobile learning designers need to consider the context of use of mobile applications. Through considering the context, then resources can be streamlined to eliminate clutter. This makes resources more fit for purpose and relevant to users.

**Logical:** The next design principle suggests that on-demand resources need to be grouped appropriately to make the information easily identifiable. The on-demand resources should be associated with locations, tasks, or types of equipment. This will assist students with searching for information, improving potential response times associated with on-demand learning. This design principle evolved from the academic staff interviews. This supports mobile learning design principles, which also acknowledge the need for mobile applications to be easy to use (Banga & Weinholdt, 2014).

**Engaging:** Another design principle identified through the academic staff interviews was that on-demand resources should engage a contemporary audience. The suggestion of this design principle is that on-demand resources need to be produced professionally and appeal to the student demographic. On-demand resources need to mimic the learning resources available outside of formal education to keep a contemporary edge. This is a recognised principle of mobile application design, as popular applications can be important sources of inspiration for interaction design (Banga & Weinholdt, 2014).

**Differentiated:** On-demand resources should cater for student diversity in skill level and genre as a design principle. Throughout the academic staff interviews it was identified that the students within this study had diverse skill sets. On-demand resources need to accommodate the needs of students from the various year levels of the program, through providing differentiated

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content. It is also important to consider the needs of students working within other genres, where production techniques can vary. Therefore on-demand resources can provide differentiated content based on genre to engage interest groups. Mobile learning design principles suggest that it is important to anticipate the needs of users and how they will interact with the mobile application (Banga & Weinholdt, 2014; Lechler & Hosack, 2014). Differentiating on-demand resources through understanding the demographic being targeted is relevant to affective design.

**Supplementary:** On-demand resources need to be designed as a supplement to a range of primary education activities. They need to complement and support the other learning activities through offering learning opportunities during the application of popular music production project work. This design principle was deliberated during the academic staff interviews. Mobile learning has been recognised as a supplementary learning tool for music education, that provides on-demand information useful for practical activities (Chen, 2015; Wallerstedt & Hillman, 2015).

**Student-Driven Content:** On-demand resources should incorporate student-driven content, whether from interaction through social media or through facilitating the development of student demonstrations. Through the academic staff interviews the importance of peer learning was highlighted. Participatory culture and the use of digital technologies through user-generated content, has the potential to inform music education (Waldron, 2013). Student-driven content could provide an engaging outlet for students that aligns with learning outside of formal education (Jenkins, Clinton, Purushotma, Robison & Weigel, 2009; Waldron, Mantie, Partti, & Tobias, 2018).

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These preliminary design principles were used to progress the research to the next iteration. The design principles reflected the outcomes of the pilot study, which sought to establish a base configuration for delivering on-demand resources.
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Research Iteration 2: Mobile Application Development

5.1 Overview

Following the pilot study undertaken in 2015, expansion of on-demand resource development and sharing began with the BPM student cohort. This included the development of a range of additional resource tutorials to support students working their way through the later stages of the program. One of the primary considerations at this stage of the project was the development of a mobile phone application as a delivery platform for the tutorial resources. This embodied the need for on-demand resources to be mobile device compatible. In conjunction with the development of the mobile phone application there were a number of minor resource design modifications designed to address the preliminary design principles identified through the pilot study. The insights garnered through the interviews conducted with six BPM staff also played an important role in developing a direction for the resource modification. A number of common themes emerged through the staff interviews, student interviews, and focus groups conducted during the pilot study. These included a range of design principles in relation to the development of on-demand resources for supporting students learning popular music production.

5.2 Resource Modification and Development

Initially, the main focus of the resource modification and development involved the creation of additional on-demand resources to expand the range of equipment tutorials available. This addressed the need to provide differentiated on-demand resources to the students from all stages of the program. The pilot study research had highlighted the need to address equipment and scenarios relevant to all students, which assisted with problem solving and knowledge extension. This included developing task-specific technical resources
covering the equipment found in studio spaces used by more advanced BPM students. This would assist students working their way through the second and third year of the program where the studio production focus becomes increasingly complex. In order to address the task-specific design, resources covered troubleshooting and basic set-up procedures designed to assist students with both hardware and software configuration. These included tutorials covering headphone set-up procedures, audio monitoring configuration, audio hardware configuration, and software configuration. They provided task-specific and supplementary tutorials on music technology encountered within the studio spaces used by second- and third-year students. One example of this was the development of tutorials covering technical operation of the facility’s main audio console, the Solid State Logic AWS900. This console is used during music production coursework delivered to students in the third year of the program; it often causes confusion for some students, due to the range of processing options and the more advanced nature of its operation.

Other minor on-demand resource modifications addressed at this stage of the project included shifting the focus towards shorter video content to make the tutorials more succinct. This was done to make the tutorial content more engaging. Having shorter video content aligns with the task specific design principle, as the principle suggests that resources should focus on basic set-up procedures and troubleshooting. The use of shorter video content is also a recognised design principle of mobile learning. Gu et al (2006) suggest that mobile learning opportunities need to be able to fit into shorter time-frames, as users of mobile learning generally have less time to engage in a topic. In response to student feedback during the pilot study, some PDF documents were also created as basic troubleshooting resources for commonly encountered problems. This was incorporated because of the need to provide on-demand resources which were contextual to individual tasks or problems often related to configuring the various systems within the studios to be able to play back recordings via the Pro Tools HDX audio system. These resources were shared to YouTube on the study channel (see Figure 13). Playlist categories were created to enhance accessibility for students in response to the need for logical, structured design. These playlists covered topics such as
recording techniques, software, outboard audio hardware, and other relevant groupings.

Figure 13. Aspects of BPM Studios1 YouTube channel.

5.3 Mobile Application Development

Development of a mobile application for sharing these resources was prioritised because of the strong support students demonstrated during the pilot study for mobile device compatible delivery methods (See Appendix C). Mobile delivery has an important role to play in post-secondary education. For example, Martin and Ertzberger (2013) suggested that mobile learning has the potential to increase student engagement in learning, as mobile technologies are pervasive in the daily lives of many students. Through the use of mobile technologies, students engage with applying a range of skills to decode and apply information in an on-demand context (Martin & Ertzberger, 2013). Technology forecasters have suggested that institutions should be engaging with incorporating mobile technologies into post-secondary education delivery as these technologies have the potential to enhance student engagement (Adams Becker et al., 2017). The development of the mobile application had by this stage become the main consideration for the project, as it was anticipated that this would be the most effective way of sharing on-demand resources. Whilst other delivery methods had been utilised during the early stages of the project, it was identified that a
mobile application would offer greater accessibility to the BPM cohort. The creation of an Apple iBook seemed to work effectively for sharing the resources on the studio computers; however, the download size inhibited students wanting to download this to their personal devices. Creation of a mobile application would afford students the ability to access information on demand more conveniently.

After the initial investigation it was decided to build the application using the online mobile application generator Appy Pie. This method of building a mobile application allowed linkages to social media and to the range of on-demand video resources stored on the YouTube channel. The application’s main focus would be to share the on-demand resources created for the project. Building the mobile application using Appy Pie was straightforward and economical. The drag-and-drop system used for building the application worked effectively, allowing linking of the YouTube playlists incorporated in the project channel to the application. There were other aspects of social media also included in this initial design, namely the BPM Studios Facebook page and Twitter feed. Building the mobile application using this kind of service worked effectively for the context of this project, allowing focus on the design aspects of the application rather than the technical considerations. It did mean, however, that the design was constrained by the design elements available in the Appy Pie system.

Once the application was built into a test instance, it was shared with a group of ten BPM students to gain feedback on the initial design. These students were contacted via social media and those who expressed an interested in providing feedback were provided a link to download the test application. The initial design of the application included links to the YouTube playlist categories covering on-demand resources, which grouped recording studio spaces, equipment, and popular music production techniques. This was done to address the need for on-demand resource design to provide logical structure to speed up the process of searching for relevant information. The tutorial categories addressed some of the preliminary design principles, which included:

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10 Appy Pie allows anyone, even those with no technical knowledge, to create mobile phone applications through a web-based application builder.
THE DESIGN PRINCIPLES OF ON-DEMAND LEARNING:
A DESIGN-BASED RESEARCH STUDY OF EDUCATIVE PROVISIONING IN POPULAR MUSIC PRODUCTION

- Audio equipment tutorials – where information related to hardware including pre-amplifiers, compressors, equalisers, and other equipment was covered. This provided supplementary knowledge of the function of these pieces of equipment.
- Recording tutorials – covering the various microphone placement techniques used for recording drums, guitars, vocals, and other recording techniques. This was included to offer supplementary information to assist with popular music production skill development.
- SSL AWS 900 tutorials – specific information relayed regarding operation of Studio A’s console the SSL AWS900. This task-specific information was aimed at third-year students who primarily used this studio. It provided differentiated tutorials on the use of this piece of equipment relevant to this group of students.
- Headphone set-up tutorials – covering how to use the headphone monitoring systems of the various studios providing task-specific solutions. This was included because students commonly experienced technical issues during this aspect of recording. These were differentiated to address the requirements of the students across the program through coverage of the various studio spaces.\(^\text{11}\)
- Software tutorials – this playlist incorporated task-specific aspects of hardware/software configuration. These tutorials included learning how to set-up the digital audio system inputs and outputs, as well as general tutorials related to the program Pro Tools.
- C24 control surface tutorials – this covered the use of the C24 control surface primarily used in Studios C and D by first-year BPM students. This was differentiated to incorporate resources relevant to those particular groups of students.

The links allowed playback of the video content within the application and the playlist categories were grouped to provide easy access to the students based on their needs. This was in response to the requirement for the on-demand resource design to be logical, task specific, and differentiated. Other page links within the mobile application included to the

\(^{11}\text{BPM students are provided incremental access to recording studios based on their year level. These studios differ in their headphone set-up configuration.}\)
studio booking system, fault reporting forms, the studio Facebook page feed, contact information, Griffith University email and Blackboard services, and a localised social network. The general idea of the mobile application was to provide BPM students with a simple way of accessing tutorials, along with a range of other services that they would utilize during their studies. The test instance of the application provided the opportunity for BPM staff and students to deliver feedback. This allowed design modification before the application was shared to the Google Play and Apple iTunes stores. The mobile device application at this stage used an icon-based layout, with individual photos for each of the categories. This was incorporated to utilise a more visual aesthetic to the application, which could potentially assist with finding information quickly.

5.4 Mobile Application Focus Group

The phase 3 focus group was conducted with four students to gain additional insight into which design aspects the student cohort thought worked and which required modification. The student focus group was given early access to the application via a link allowing them to download it from the Appy Pie server. Four students actively participated in this focus group, providing formal feedback on the mobile application. The focus group was open to all current BPM students, with those who participated coming from across the BPM cohort. Participant one was a first-year student and will be identified as Student one. This student’s focus in the music industry is predominantly as a performer, although he also has experience working in live technical production. The second participant was also a first-year student and will be identified as Student two; this student identifies mainly as a performer and songwriter, though he also regularly engages with music technology through his portfolio work. The third participant was a third-year student and will be identified as Student three. This student works as a songwriter/performer, but also has a strong focus in the music production area. The fourth participant was a third-year student and will be identified as Student four. This student is an instrumentalist with a focus on music production as well.

The students were asked ten questions regarding the layout of the application and how
useful aspects of the application were. This facet was a primary consideration of the research because layout is an important design principle to consider when developing mobile learning tools. Through an effective layout, the logical and differentiated nature of the on-demand resources can be enhanced. The students were also asked questions about potential usage patterns and how they viewed the application in an overall sense. The participants were initially asked about their impressions of the layout of the application, and whether this suited their needs. This question was asked in alignment with the design principle that suggests that on-demand resources need to be logical. The student responses as a theme were generally positive, highlighting the accessibility of the links.

It's good. It's accessible. Everything's clear and obvious in terms of what you want to navigate to and learn about. I find that's all it needs to be, in my opinion. It doesn't need to be overly sophisticated. It's clear and succinct. It worked for me. (Student 1)

The other members of the focus group felt generally the same, although there were some points made regarding how the icons appeared in the application.

The layout seems good; it gives links to everything you want in the app, the only improvement I could think of is some of the names don’t display, as they're too long. It can be hard to tell what a link is linking to. (Student 4)

This concern was addressed through a major change in the layout of the application home page. Lecheler and Hosack (2014) propose that designers need to strongly consider how information is displayed, potentially incorporating a visual element into the display to assist users to interpret the information quickly. What was discovered through the focus group was that the text-based layout of the home screen in the mobile application needed to be easy to read and to understand. While initially there were icons for the various categories, these were exchanged for a list-styled presentation because of the limitation of the text that could be incorporated into the icons. Using a list styled menu presentation allowed full descriptions of the various categories and tutorials, meaning that there was easier navigation for the users (see Figure 14).
There was also some commentary amongst the focus group regarding how some of the icons appeared on the home screen of the application. Though in general it was felt the application was clear, one minor issue was noted. This was pixilation of some of the screen icons, making them difficult to read.

Yeah, it's really clear. The only thing is there are just certain images that look a bit pixelated, like the add-to contacts and things like that. But it is an information-based thing. It not necessarily needs to be all pretty and perfect, if that makes sense.

(Student 3)

These aspects of the design were modified to address the concerns through removing this particular feature. The add-to contacts icon was removed from the various staff contact pages, because it was causing the application to crash. Though this was investigated by Appy Pie support, no solution was available. Removing this icon stopped any potential crashes and also resolved the pixelated icon on the various pages.

The focus group was also asked if there were aspects of the layout that could be improved. Only one student responded to this question, as the others had made comment regarding
small issues that they had noticed. Once again the key theme of logical was obvious from the response, which highlighted the need for simplicity.

Honestly, no. I feel I like the app is, by design, spartan. So I think that's probably the best way to have it. There's nothing to confuse you when you're stressed out at one o'clock in the morning. So it's probably the best possible thing. (Student 2)

Gu et al. (2011) recognise that users of mobile learning technologies need to be able to quickly recognise information because time is often limited, as they are focused on other tasks. The responses of the BPM student focus group reinforced the design principle developed during the pilot study that on-demand resources need to be logical, well organised, and accessible (see Figure 15). The participants in the student focus group all agreed that having a logical design, which enables easy access to information is vital to the usability of this resource. This design principle is highly relevant for mobile learning and for users of on-demand resources learning skills in popular music production. Working in the recording studio is often intense, and technical issues can distract from creative flow/continuity, something that has significance in popular music production.

Figure 15. BPMStudios tutorial layout.
The next themes that were investigated concentrated on the inclusion of specific pages within the application and whether these were relevant to the students’ needs. Some researchers suggest that social media has become highly relevant to higher education (Cooke, 2017). However other researchers highlight that the uptake of social media has been relatively slow, with obstacles such as “cultural resistance, traditional visions of instruction, lack of technical support and perceived risks” influencing academic staff (Manca and Ranieri, 2016). While social media sites rise and fall in popularity, the basic premise of social media remains constant being a focus on “openly shared digital content that is authored, critiqued and reconfigured by a mass of users” (Selwyn, 2012, p. 1). The mobile application included links to external social media including Facebook and Twitter, as well as a page for sharing studio updates. This was put in place to investigate the impact of student developed content within the application design. However there were also service pages incorporated into the application design to facilitate on-demand information. The first page the students were asked about was the studio updates page, which allowed news to be shared with the cohort via the application. All four students involved in the focus group felt that this page was a useful addition to the application. Student 4 commented, “studio updates are good” while the other participants, answered in the affirmative across the board. Student 2 commented that this feature had potential for informing students regarding outages and other associated issues that occur occasionally. He stated, “I feel like this especially could be useful just before you came in, check the app, see if anything's gone down that would ruin a session” (Student 2). This theme suggests that students viewed the mobile application as having relevance with managing their use of the recording facilities. Students identified during the focus groups that they felt that resources that assisted them with troubleshooting technical issues would be relevant on-demand learning materials. Providing on-demand information in relation to studio updates, shares relevant information that can save students time in the studios, assisting them to identify issues quickly.

The next theme investigated was the incorporation of social media for sharing on-demand information. A Twitter feed was also created and linked to the mobile application
during the initial design phase. This was because of the potential for the use of Twitter as another method of sharing simple updates related to the studio for the student cohort. Once discussion during the focus group turned to Twitter, it was established that this feature was an unnecessary addition to the application. The information-sharing capability of Twitter already being covered through the studio updates page or the Facebook page feed. The consensus amongst all students participating in the focus group was that few students were currently using Twitter within the BPM program. Therefore it was perhaps not necessary to incorporate it into the design. Student 3 summed up the feelings of the group, while flagging the need to be mindful of changing trends in social media usage and the impact that could have over time.

Personally, I don't use Twitter a lot, if at all. So, personally, probably not, but social media's changing all the time. Facebook's the thing in Australia right now, but it's not going to be for the next five or 10 years even. So it's sort of one of those things where maybe, as everything changes, you'll just have to adapt the app to whatever everyone's using. (Student 3)

This student went on to comment that Twitter had more relevance in other countries and was something generally used overseas and to follow various celebrities, not education institutions. These sentiments were echoed by other participants in the focus group who also didn’t see it as a vital part of their social media interests.

Twitter's not something I use. It's not something that I'd go to on the app if it was the option to go on it and use it for some particular thing to do with BPM. But, as it was pointed out, it's a very valid point. Social media's constantly changing. (Student 1)

The incorporation of the studio updates page, the potential for sending push notifications, and utilising the Facebook page feed seemed to be already covering this function within the BPMStudios1 application. It was decided to remove the Twitter feature from the revision of the app design to simplify managing information.

The feed from the BPM Studios Facebook page was a feature that was incorporated early into the mobile application design, because of the high level of engagement within the
BPM cohort in using Facebook to network and share information. One of the design principles developed from the pilot study was that student developed content should be incorporated into on-demand resources. This was because academic staff clearly saw the value of informal learning within the program. Participatory culture is also highly relevant to music education and should be considered for integration into formal music education (Waldron, Mantie, Partti & Tobias, 2018). The official school Facebook page -- the BPM Noticeboard -- is the primary space where students and staff engage in exchanging information related to music and school activities. The BPM Studios page was started to establish a culture of sharing technical and music production related information through a specific social media page. It was created to develop an online environment where informal learning of music technology could be facilitated and encouraged because student-driven content was identified as a preliminary design principle. The page also allowed students to contribute through giving them the opportunity to develop their presence within the mobile application. Students in the current cohort have engaged with following this page as a means of receiving relevant information and updates, though at the time of writing dialogue between the users is limited. The students participating within the focus group indicated that the page was both valuable and should be included into the application design. This reinforced the design principle that student developed content should be incorporated into on-demand resources. The ability to search for information within Facebook was viewed as a highly relevant tool by the focus group participants.

Yeah, I found it's good because you can just click on it and navigate through it if you're looking for something in particular, rather than going to Facebook or whatnot. I think it should be there because it's an active part of the BPM program. So, if it's in the app, I think it's appropriate, yeah. (Student 1)

Student 2 also reflected on this feature: “Facebook has that enhanced search feature with the groups. So that's really a good tool to use”. Because this page is highly relevant to the social media usage of BPM students, it was decided that it would remain as a page within the mobile application.
The next theme investigated followed the need for layout of information to be logical, as identified during the pilot study. The first question asked of the focus group related to the YouTube playlist categories listed on the BPMStudios1 application. These playlists constituted the main way for students to engage in on-demand learning through the mobile application. They also facilitated access to information, so it was necessary to investigate whether this was logical in its design. Playlist categories covering the operation of a range of music technologies found in the studios were linked to the mobile app via YouTube playlists (see Figure 16). These categories included tutorials on audio control surfaces, outboard audio equipment, recording techniques, software operation, and a range of associated subjects. The categories were differentiated to provide accessibility based on the students’ needs at various stages of the program. They also catered for a range of task-specific problem areas that students often encountered while using the recording studios.

![Figure 16. BPMStudios tutorial categories.](image)

The focus group was asked if the playlist categories responded to their needs for learning skills in popular music production. In general, the students in the focus group felt that the playlist categories were appropriate. The development of the playlist categories was
informed by the initial design principles developed during the pilot study, through which it was established that the grouping of on-demand resources should be logical and should cover relevant spaces, equipment, and popular music production techniques. Once again, the idea of on-demand resources supporting students to troubleshoot came through strongly, as often in the conversations with students it became apparent that they saw the mobile learning tool as filling this particular need. This could be demonstrated by the response of Student 1 to the question about the layout of the playlist categories. This student felt that the categories were relevant to the current usage patterns of the BPM cohort.

Yeah, they're right there. The ones you want are under a sub-heading. If you're having a headphone problem, you can navigate the headphones and whatever you want to look at, if you're on the SSL and you're having an issue or you want to know something about it, then it's there. The same with obviously us in first year, the C24. If you're having a control surface issue or you want to know something about the control surface that you may have missed in a tutorial or whatever, then jump on and it's play listed there for you. That's my view, yeah. (Student 1)

There were some suggestions for an additional category to be added to answer frequently asked questions (FAQ). This suggests that a group providing accessible information related to commonly experienced issues should be incorporated. Through my own observations providing technical support to these students I have noted the tendency for students to ask similar questions related to studio operation. Providing students with a FAQ playlist category would offer quick and easy contextual information while using the recording studio equipment. While some studio-related issues could be solved through an online search, the focus group felt this could be problematic.

Yeah, things like the headphone tutorial I would have loved to have in first year, because it confused me completely. So it's great that there are more resources. I came into the course with no knowledge of studios and things like that. So sometimes Googling information that I'm trying to specifically find was obscure in the answers. (Student 3)
All four participants in the focus group indicated that the specific contextual information delivered through the BPMStudios application tutorials was more valuable than information they could collect themselves. The personalised nature of the learning offered through the playlists was also noted as valuable by student 3, who stated, “having the lecturer chatting along in the studio that you're sitting in and going through it seems to be a bit more easy to follow, especially if you're new to it.” In response to this a FAQ category was added to YouTube and then linked to version two of the mobile application. The other playlist categories included in the application were related to student needs across the program. This included playlists that covered tutorials on recording technique. Interviews with academic staff suggested that this is something particularly useful to first-year students finding their way in the early days of their studies. Students also indicated during the pilot study survey their preference for information on recording techniques. Other categories focused on the use of specific audio desks, software use, setting up headphone monitoring, and a range of other concepts.

The focus group was then asked questions related to the app and its usability while operating a studio, including whether they could see themselves using it to learn or fault find in these situations. This was to investigate whether the design of the application was fitting the intended purpose, as a means of supporting students in their popular music production activities. Student 3 commented:

I think so, especially in first and second year – even in third year. Learning about the SSL desk is just a whole new thing. Until you've been doing it for a certain amount of time, you forgot little details. It's just one button that you forgot to push, one thing you haven't quite patched right. It would be great to just have that little reminder to be able to go through the process with if you need it. (Student 3)

The idea of the value of mobile learning was another theme advanced by the students who viewed the interaction with concepts via a mobile phone as a natural extension of the tools available to them. This was identified as an overarching design principle applicable to the
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delivery of on-demand resources. Student 2 considered that it was a natural extension of how he would work, as this was the technology that was always there to be utilised.

I think if your phone is the device with you the most throughout your day, then just to have that as companion, definitely. Even just to make sure you're setting up the session correctly, as like a preventative measure it would be useful. (Student 2)

The specificity of the mobile application to the needs of the BPM student cohort was also recognised as an advantage. Student 1 commented, “I think the app's great for that because you always have your phone” reinforcing Student 2’s thoughts about the accessibility of a mobile learning application. Gu et al. (2011) in their research argue that mobile application design should provide a contextualised experience for learners who can incorporate it into their learning experiences. Student 1 felt that the mobile application would be a more efficient way of accessing relevant information than a Google search.

My first thoughts are to go to Google rather than even thinking about the YouTube page with the BPM studios. Now, having the app, if I encounter an issue, I'd definitely go to the app first because it's unique to that space and what I'm using here. (Student 1)

Student 4 also supported the notion of mobile learning and felt that the application would “be useful for people and would let them learn how to solve their own problems without asking others for help.” The focus group was also asked about the general design of the application and if there were any suggestions for improvements. There was a consensus amongst the focus group that the design was logical and well structured, though there were a few minor ideas flagged as a potential way of improving it. It was proposed that the addition of contact information for staff could assist students through easy access to these details. It was also proposed that the application could link to the resource booking system used by the students for equipment and studio reservations.

5.5 Salient Findings

The incorporation of the mobile phone application as an on-demand learning resource
received support from all members of the focus group testing the initial design of the application. These students indicated that the application facilitated access to on-demand resources that had the potential to support their popular music production activities. Moving towards the third and final iteration of the project this demonstrated that mobile device compatible functionality is a fundamental design principle for the delivery of on-demand resources for supporting these students. This was evidenced by the support demonstrated for delivery via mobile devices through the surveys conducted during the pilot study. It was then reinforced by the student focus group testing the initial design of the mobile application.

Once the focus group had been concluded, further work was performed on the mobile application to address the ideas that came forward before releasing it to the general cohort. The basic layout of the application home page was changed to improve the clarity of the layout and improve the usability of the phone application. The original layout used visual icons to link to the various tutorial and services categories; this was changed in favour of a simpler, text-based layout as this allowed for detailed descriptions of the playlist categories. This would assist to speed up search times and to make the application more logical in its’ design. A frequently asked questions playlist was added to YouTube, which was then linked to the mobile application. This category was included to facilitate access to task-specific issues that students encountered while using the recording studios.

The services section of the application was also refined at this stage of the project, to make it more relevant to the student users. The Twitter feed was removed as this style of information was being covered by the studio updates page already housed in the application design. In response to student requests, the contact details were added for studio management, course conveners, and administrative staff within the BPM program. This allowed students easy access to this service information. There was a range of other services that were added to increase the potential of the application for students. Other links added to the page included the Griffith University service My Griffith, along with student email, resource booking, and fault-reporting systems. These additions provided a form of integration with the university learning management systems to enable movement between
Once the refinements of the application were made it was then submitted to the Apple iTunes and Google Play stores for approval and distribution.
Research Iteration 3: Mobile Application Evaluation

6.1 BPM Studios Mobile Application Distribution

The mobile phone application (BPM Studios\textsuperscript{12}) was distributed via the Apple iTunes and Google Play stores in January 2017. The next step involved raising student awareness of the availability of the application. This promotional stage aimed to gain the maximum number of student users as possible. In order to achieve this, first-year students were delivered an overview of the application during student orientation. It was anticipated that the new cohort would potentially engage with downloading the application. Promotion was also undertaken through social media to target the student cohort. This aimed to promote availability of the application to continuing BPM students through the BPM Noticeboard student page. Promotion of the application also occurred with the student cohort during Popular Music Production lectures early in the trimester.

6.2 Research Process

During the first trimester of 2017, research was conducted to evaluate student perceptions regarding usability of the mobile phone application. This research was conducted to investigate the fundamental research questions emerging from the previous research iterations. This iteration of the research process sought to answer the following questions.

- Were students engaging with the mobile phone application?
- When were students using the mobile phone application, and for what purposes?
- What recommendations did students have for potential design improvements?

\textsuperscript{12} The mobile application was named BPM Studios: this should not be confused with the YouTube channel named BPM Studios\textsuperscript{1}.
There were two research instruments used during this iteration. The first was a survey of five questions, designed to assess student engagement patterns with the BPM Studios application. This survey included three multiple choice and two short-answer questions.

The second research instrument conducted was a focus group that aimed to add depth to student perspectives on the BPM Studios application. It was conducted with a purposive sample of four students from across the program. The students participating in the focus group identified as having different primary focuses with their musical activities. One identified as a music producer, focused on recording and programming music; one identified as an instrumentalist whose key focus was on drumming as a session and live performer; and the other two students identified as singer/songwriter/performers.

With the exception of the student who identified as a music producer, the other students engaged with using music technology as an extension of their other musical activities. When they did engage with operating recording studios, they were often working on smaller projects. These students acknowledged a limited understanding of some aspects of studio operation. Even though this is the case, all students have been involved in numerous recording projects. Their work in preparing portfolio material for the program’s major study, Popular Music Production, gave them a thorough understanding of the recording process.

### 6.3 Mobile Application Evaluation: Survey Results

There were 30 survey participants from across the three years of the BPM program from a cohort of 120. This represents 25% of the cohort participating in the survey. The survey asked the following questions:

1. What year level of the BPM program are you?
2. Are you using the mobile phone application?
3. Do you think the mobile phone application is an effective delivery method for helping you learn about popular music production?
4. When are you using the mobile phone application?
5. How do you think the mobile phone application design could be improved?
There were five main themes that were identified through the survey. Three of the themes reinforced the themes identified during the pilot study. Two themes were additional and contributed new ideas towards the development of design principles. The first theme suggested that delivery via mobile devices was the most appropriate for the context of on-demand resource delivery, and that students felt that this was an effective learning tool. The next theme reiterated the task-specific focus of on-demand education, with students highlighting how they were using the application. The third theme suggested that on-demand resources needed to be engaging, and that aesthetic design needed due attention. There were new themes evidence through the survey that suggested that resources needed to be extensive, covering a variety of scenarios and that these needed to be regularly reviewed to ensure relevance. The final theme was the integration of other university services with the application, to enable students to manage other aspects of their learning activities.

The first question asked students to specify the year level of the program to allow bivariate analysis of the data based on year level. This assisted with determining if the needs of students changed at various stages of the program. The survey participants consisted of 12 third-year students, along with nine from the second year of the program and nine from the first year. This sample represented an even spread of participants, with a slightly higher participation rate in the third-year cohort.

The second question asked the participants if they were using the mobile phone application. Research conducted during the pilot study suggested the theme that students felt they would engage with using mobile devices to support their learning. The survey participants identified that the majority of them -- 25 of the 30 -- were using the mobile phone application, while five students were not using it. The next question asked students if they felt the mobile phone application was an effective delivery method for helping to learn about recording studio operation. A similar question was asked during the pilot study, but not specifically related to the use of a mobile phone application. During that iteration of the research it was identified that many students felt that on-demand education was effective for helping them to learn. In this iteration of the research the students reinforced the theme that
mobile devices were viewed as effective in helping them to learn. This question used a five-point Likert scale format to measure the attitudinal response of the survey participants; many of them agreed that the mobile phone application is effective in helping them to learn about popular music production. Twenty-two participants agreed, while three strongly agreed that it effectively assists them to learn about recording studio operation (see Figure 17).

![Student Perceptions](image)

*Figure 17. Student perceptions of effectiveness of the mobile phone application.*

Bivariate analysis of the survey results noted that this response was evenly balanced across the year levels of the program. There were seven students from first year, eight from second year and seven from the third year of the program that agreed with the statement. The three students who strongly agreed with the question all came from the final year of the program, though it was not considered that this had particular significance.

The next theme suggested that students were using the mobile application for learning task-specific music technology procedures. This theme was identified through the short answer question “when are you using the mobile phone application?” Short answer questions were incorporated into the research design to give survey participants the opportunity to offer their individual experiences of using the mobile phone application. Through the responses to this question it was expected to gain more insight into the various contexts in which BPM students were using this learning tool. The responses to this question were
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coded to identify recurring themes; through this thematic analysis, two themes related to student use of the phone application were identified. The theme that emerged reinforced that students were using the application in a learning context to assist with learning task-specific procedures, as its primary function (see Appendix B: Table B1). This aligns with the task-specific design principle that was acknowledged during the pilot study.

The short answer question responses demonstrated that often students were using the mobile application to review task-specific procedures during studio recording sessions. The point at which the task-specific information became relevant to the students was when they were at a specific moment of need. One student reflected that the mobile application was useful “when I'm stumped in the studio and needing assistance with a particular device or technique”. This suggested that students were using the mobile application to provide supplementary on-demand learning opportunities when they needed it most. The survey responses of sixteen other participants reiterated this idea. Another participant recounted how the application assisted when no other help was available. This student stated that the application was used “late at night, out of staffed hours when I am recording in the studios alone”. The idea of the mobile phone application as a place to go when other avenues of assistance are unavailable, and when there is a specific learning need, was a common thread. This implied that the most useful feature of the mobile phone application was that it provided a source of information to assist with task-specific procedures. These responses can be summarised by the student who described the context in which they used the application as “whenever I get confused in the studios.” These results reinforce the design principle developed during the pilot study that BPM students would engage with mobile learning to develop their skills in popular music production. During research iteration1: the pilot study, students supported the concept, which led to the development of the mobile phone application. During this iteration of the research the data gathered identified that BPM students were engaging with this learning tool. These students were also using the phone application on demand to support their recording activities.

The next theme identified that generally students were happy with the mobile
Students were asked how they thought the mobile phone application design could be enhanced (see Appendix B: Table B2). This question was designed to deliver a student perspective on the design structure currently in use, with a view to potential design modifications in the future. Six of the survey participants suggested that they were happy with the design as it is, feeling that it was unnecessary to revise it based on their experience. One of these participants suggested that “I think for what it is and how I use it, the structure is pretty good. Nothing immediately comes to mind that I would want to change”. Other survey participants identified that they had similar opinions.

However another theme suggested that there were some students that felt the design could be more engaging. One student suggested that the “user interface could look nicer” while another felt that “maybe a more user friendly interface” would be appropriate. One of the initial design principles was that on-demand resources should be engaging through exhibiting good production values that connect with a contemporary audience. After the initial design of the application some revisions were made based on feedback from the student focus group. During this phase the design was revised to make the titles of the categories more intuitive to understand. The current design could be described as functional, rather than focused on being aesthetic. This may have led some users to feel that the design was not engaging, though the results of this were not conclusive.

The next theme emphasised through the responses to this question was integration of university services within the application. Although the principal purpose of the application was to offer on-demand learning opportunities, it was decided to integrate useful services into the initial design to give students the opportunity to engage with these through the mobile phone application. Given the problematic nature of integrating all of these services, a design principle emerged that suggests that the application should focus on delivering learning opportunities to students. The Griffith University’s online systems My Griffith, Learning at Griffith, and access to email utilise a single sign-on system. Some students accessing these services via the application experienced issues with the single sign-on system. As one survey participant commented, “I find it very frustrating when I have to
constantly log in to my account even if I have used it five minutes prior to logging in.” This was reinforced by another participant who observed, “perhaps if the app had a single sign on function then students wouldn’t have to log in to the Griffith site every time.” While the addition of Griffith services to the application design may have been beneficial because of budgetary considerations, these were all added as external links in the application. This may have been one aspect of the application design that, while useful, could have been left out at this stage of development.

There were other comments that reinforced the theme of integration. A number of students commented that they felt the incorporation of other BPM online learning tools could be beneficial. BoPMAT is an online resource used to provide feedback, marks, and a listening space for student portfolio submissions. There were comments from survey participants regarding potentially integrating BoPMAT into the application to provide access to portfolio material submissions. As proposed by one student, “I feel like it would be very handy to be able to access BoPMAT via the phone app so people can listen to their panel, hot 100 or check their folio assessments. Other students also suggested that BoPMAT access would be beneficial to them. Based on this feedback, a further design principle could be the development of an integrated application with multiple uses for learning and assessment. The comments related to students seeking access to BoPMAT via the mobile application suggest that there could be student demand for this service.

A final theme that emerged through this question was that tutorial content should be regularly reviewed to established continued relevance. While a range of content was created for the purpose of on-demand learning, the number of potential resources that could be developed is extensive. The constant cycle of new resources and techniques means that on-demand tutorials can quickly lose relevance. This design principle suggests that in the delivery of on-demand resources, developing fresh content and new resources is important to keep students engaged in the learning process. One student commented, “I think more advanced videos covering new equipment would be helpful”. Another student suggested that

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13 BoPMAT provides opportunities for students to listen to the portfolio submissions of other students. The hot 100 is the top 100 tracks submitted during each semester.
there could be “more videos on the latest studio gear.” Overall, this demonstrates that continuing to develop resources for this form of learning tool is extremely important in maintaining a vital and useful learning space.

6.4 BPM Studios Mobile Phone Application Focus Group

A focus group was also conducted with four students at the conclusion of the teaching period to evaluate the mobile phone application. This focus group was used to gather information about how students were utilizing the application, while gathering feedback on the structure to refine the identified design principles. Lecheler and Hosack (2014) state that understanding the intended users and how they interact with the mobile application is an important consideration for developing design principles. This observation was important to this study because it was important to understand whether this delivery method was having the intended impact. Gaining an understanding of how it was being used would provide context for the refined application design principles.

There were four BPM student participants involved in this final focus group. The first student was in the third year of the program and will be identified as Student 1. This student was identified as a music producer, and regularly works with music technology in the recording studios. Student 2 is also in the third year of the program. A proficient drummer, this student regularly worked as a session drummer on many projects within the university studios, and also occasionally engages in popular music production through engineering and producing music. The third student was completing the second year of the BPM program. Student 3 identified as a singer/songwriter who uses music technology, but generally worked as a performer. Student 4 was enrolled in the second year of the program. This student worked as a singer/songwriter and had limited engagement with the use of music technology. The students volunteered to participate in the focus group and they represent a range of attributes often found within the BPM student demographic, thus representing a purposive sample. These students had all used the mobile phone application during their work in the studio throughout the first trimester of 2017.
The first question asked was how and when students were using the mobile phone application. This question was also asked during the survey as an open question. The students in the focus group responded that they had used the mobile phone application throughout the trimester. The main theme established was that they had used it to troubleshoot equipment operation when faced with unfamiliar situations. Using on-demand resources to troubleshoot music technology equipment has been a recurring theme throughout the project. Student 1 recalled a circumstance when the application assisted with solving a technical problem during a studio session.

I've used it when I've been stuck in Studio A. One – I remember there was an issue connecting Pro Tools to the desk. I would have had no idea how to fix it and – yeah, the app just shows you how to reconnect it. It really helped. (Student 1)

The other three members of the focus group had also encountered similar situations, which reiterated this theme. Student 2 encountered a situation where the application conveyed important information regarding headphone configuration. Student 2 reflected that “I used it more for headphones and stuff because I'm not really an engineer oriented person. So I just do it for simple things in the studio if I'm stuck.” Other students participating in the focus group had similar experiences. They felt that the application worked well for them because it supported their use of the studio. It gave them more confidence in their ability to get the job done. Student 4 doesn’t often take on the role of audio engineer and also felt the application was an effective tool to support her recording activities.

Because I am not hugely confident in the studios, an app like this, with its simple layout, helps me a lot in finding the required information I need when I go into the studio by myself. Everything is easy to see and watching the videos helps me directly with the problems I have. (Student 4)

These responses reinforced the idea that the phone application was serving the purpose of assisting with troubleshooting for students using the recording studios. The responses to this question during the survey also recounted that the application served as a private tutor providing on-demand learning opportunities in times of need.
The series of questions sought information regarding how the mobile phone application compared to other delivery methods. The theme that developed suggested that mobile delivery was the most effective delivery method. The focus group participants agreed that the mobile phone application worked more effectively than the other delivery methods because it was the most accessible piece of technology available. Student 3 commented, “You're more likely to have your phone out when you're stressed rather than a laptop to go to YouTube or whatever. So then it makes it faster, it delivers it better.” Student 1 also felt that the mobile phone application was a better option than the other delivery methods. He commented, “Yeah. I think it's probably the best way to go because, everyone's got them on them these days.” These responses also supported the survey responses that suggested that the delivery of on-demand resources via a mobile application was the most effective delivery method.

While this series of questions sought specific information regarding the various delivery methods, some responses reflected how the application enabled their learning process. This theme suggested that students were inclined to engage with tutorials of this nature, and that they viewed this had a role to play in their learning. Student 4 indicated that the personal nature of instructional learning offered a richer learning experience that wasn’t being delivered in the classroom.

I think it does for people like me who aren’t the quickest learners in the studios. The app almost provides a “one-on-one” scenario. The step-by-step instructions make it feel like I’ve got a private teacher. For people like me who can’t obtain the information as quickly as others can in class, I think this app has a real advantage. However not just for people of my level, but all levels can benefit from this app.

(Student 4)

The discussion turned to the use of instructional learning for the development of new skills. The focus group was asked if there were other scenarios where they used the application. The members of the focus group also indicated use of the application while troubleshooting; however, the supplementary information the application could provide was another situation
where the application was being used. Student 1 commented, “I've just gone through it though sometimes and just watched some of them. Like in first year I watched a couple of them when it was just basically how to record a guitar.” This particular student was identified earlier as having a specific focus on audio engineering and music production.

While discussing the context of his use of the application, Student 1 was asked about how he learned a lot of the techniques he used to produce music. Independent research was identified as a significantly important part of how he developed new skills. It was also something that he spent a considerable amount of time doing. “Yeah. I watch a load of tutorials. I think it's huge. Everyone I think I know that does this uses them to figure stuff out and where to get new ideas.”

The focus group was then asked if they felt that the mobile phone application was an appropriate mode of delivery for this kind of information. The participants all agreed that they felt that it was relevant and effective. Overall, there was strong support for the BPM Studios mobile phone application, and the concept of on-demand resources. The attitudes reflected by the students involved in the focus group reflected those of the survey participants. Themes that surfaced from this session highlighted that students were engaging with the application to learn in a variety of contexts. Often, it was when they were in specific need of information that it was most valuable. In general, the focus group felt that the idea of a self-paced learning environment effectively supported their need. It was also relevant to help them engage with using the equipment when working alone or in unfamiliar situations.

The next question related to the structure of the mobile phone application and its general layout. The theme recognised through the focus group was that overall, the focus group felt that the layout of the application was simple and easy to use. Student 1 reflected on the layout thus: “I think it's good. I think it's well laid out and it's simple because you don't have to go through a few pages or anything. It's just boom, boom – it's all there.” This was also reiterated by Student 4, who commented that the application was “Super easy and simple! There’s really nothing else I can say but it’s great!” This was also the opinion of the other members of the focus group who found the application design user friendly. The focus group was then asked about the playlist categories and content that is currently available
through the application. They were specifically asked about the usability and how this could be enhanced. Overall, they felt there needed to be more tutorial content covering a broader range of information.

One of the initial design principles was that on-demand resources should be differentiated to cater for student diversity, covering general skills applicable to students across the degree program. This design principle also needed to address the needs of students working in different genres where different approaches in popular music production are often employed. During the course of the project, time constraints had meant that the continued development of on-demand resources had to be put on hold. While there is an extensive amount of content available, catering for student diversity meant that development of resources should not only take into account student year level, but should also cater for various production approaches. This means that resources assisting those focused on electronic music production would be highly relevant as production techniques employed in this area differ from those of rock, blues, or country.

During the focus group the theme of student developed content was then discussed as a way of increasing student engagement in using the application. Student 2 suggested this as something valuable to her learning process:

I think it could be good to if maybe you even enlisted some of the third years to put together little handy tip videos of stuff that they do. Because I know that I sort of pick up on things a lot more if I'm learning it from one of my peers, because they're doing it and they're in the same boat as me and it's like – so it's just that simple – if you can do it, so can I. (Student 2)

Student 1 also felt that students would engage with creating content, and that they had valuable skills they could share.

I reckon there would be people here who would love to do them. They could just make them up if they're here late at night one night and send them to you, if that'd be good, student tutorials. That could be another subheading. (Student 1)
All students participating in the focus group agreed that student developed content would increase student engagement in the mobile application. Some students entering into the third year of the program have developed their skills in popular music production to a professional standard. These students also often take on the role of music producer and audio engineer during group projects. Harnessing their skills and knowledge to share with their peers could be a valuable addition to the on-demand tutorials.

Additional ideas for enhancing the usability of the on-demand resources were also shared. The first theme identified that resources that focused on specific music production techniques could be a valuable addition to the tutorial playlist categories. It was suggested that these needed to deliver small chunks of information that covered very specific skills. Student 1 suggested, “I think that you would get maybe more people going there if there were some tutorials that were more like tricks or tips.” The students generally agreed with this idea. Student 1 felt that “special mixing tricks and stuff like that, because I think that's something much more eye grabbing for someone.”

The second theme reiterated that music technology tutorial videos were often too long. The suggestion was that tutorial videos needed to be succinct, conveying the information efficiently. This was not specifically referring to the BPM Studios tutorials, but referred to much of the general music production tutorial content found via YouTube.

Yeah, that's the other thing. They need to be real short and concise because there's nothing more annoying than some dude in a tutorial that starts, then you're left waiting till the actual concept is covered. (Student 1)

The focus group participants were also asked if they thought video was the most effective medium for communicating this sort of information. The participants agreed that in most cases, having a video to watch worked the most effectively for sharing these tutorials. Often the students felt that the context of the information was a determining factor. Student 3 said, “It depends on the information because for studio stuff you need to follow it step by step and it's easier to watch someone else do it”. Other members of the focus group had a similar perspective:
I think the video is the best way because text literally means nothing to me, but in a video, I’m physically seeing what’s being done and I think that’s the best way to teach studio work like this. (Student 4)

While the majority of information shared through the phone application was video based, other sorts of information were also shared during the course of the project. During the pilot study it was suggested that PDF files would be an effective means of communicating information regarding some commonly experienced issues, and some PDF documents were created and shared for this purpose. During the focus group, Student 3 shared another form of on-demand learning that she engaged with, which involved the use of images found via Google search. These images were used to display microphone placement techniques for recording various instruments: “Usually I just Google image microphone techniques for this and it pops up” (Student 3). Lecheler and Hosack (2014) propose as one of their design principles that mobile learning designers should make use of visual information to get the point across quickly, and Student 3 suggested that visual information was the most efficient way to get information regarding microphone techniques. This allowed her to visually see a quick solution. She suggested that this could be a category that could assist beginning students with learning the various microphone techniques.

I only do images for mic techniques. But for all the studio stuff I'd watch the like if I'm stuck and I'm like what am I doing, I've looked at videos. But that might be good to put in if you have just basic ones, particularly for the first years who might get stuck. (Student 3)

One of the initial design principles identified during research iteration 1, was that on-demand resources should be visual. However, the context of the information also needed to be considered when developing on-demand resources. Providing resources that conveyed information as quickly as possible through understanding the contextual nature of the lesson was highly relevant. This was echoed throughout the research. Therefore, another fundamental design principle for delivering on-demand resources is that while visual information should be heavily utilized, information context needs to be strongly considered.
This idea is also a design principle that was suggested by Lecheler and Hosack (2014) when considering mobile application design.

Finally, the group was asked if they had any other suggestions regarding the mobile phone application. There was a feeling that perhaps there was a lack of awareness of the availability of the application. During the year, effort was made to promote awareness of the application via social media and through face-to-face meetings with the student cohort. Because of the relative infancy of the application, the engagement has been steady and building. Developing a culture where the application becomes integral to the program will take time to achieve.

I think the biggest thing with this app is making people more aware of it and reminding people that it's there. Because I'd dare say that people get stuck all the time and they don't even think about it. So one idea I had is kind of simple but I thought maybe if there was a sign in the studios – like somewhere there was like are you stuck? Maybe you should download the app – you know? Because there would have been so many times where I've just gone running around looking for someone to help me and it was probably sitting in my pocket – you know, the answer. I'd just forgot. (Student 1)

6.5 Summary

This final iteration of the research process saw the BPM Studios mobile application shared with students from the BPM program. Overall, the response to the mobile application was positive, with the majority of the cohort downloading the application from the digital stores. Twenty-five students who participated in the survey and all four members of the focus group identified that they were using the phone application. These students were also using the application in a variety of contexts to help them with their Popular Music Production activities.

This research iteration aimed to assess how the mobile application was being used in order to identify other relevant design principles. This would identify how the application
could be refined in the future to make it more useful. The application was developed based on research conducted during the pilot study, which suggested that students would engage with this delivery format. Students within the BPM program indicated that they were using the phone application during the trimester. The survey revealed that 25 of the 30 participants were using the mobile application. From this pool of students, it was also apparent that they felt the phone application was effective in helping them to learn about popular music production. Through the survey responses and the focus group it was also advocated that the mobile application was a more effective way of delivering on-demand resources. This was because the application was housed on a mobile phone -- the most accessible piece of technology readily available to the students. This efficiency of information delivery was particularly relevant when the student needed information in a hurry.

The research sought to discover when, and for what purposes, the students were using the mobile phone application. Responses to this question were incorporated to inform the design principles by delivering a perspective on the most relevant features of the mobile application. Many students indicated during the survey that they were using BPM Studios mobile application. This usage often occurred during recording sessions when the application assisted them with troubleshooting basic set-up procedures. This result reflected the student responses collected during the pilot study, when they indicated that a resource to support their learning would be beneficial. This reinforced the findings of the pilot study, which indicated that a task-specific design focus was the most relevant to how the application was being used in practice. A significant proportion of these students also used the resource to administer their studio use. These students used resource booking and fault reporting to organise their recording sessions.

The final research iteration sought the student perspective on the design of the BPM Studios application. Through this iteration of the research six themes reinforced many of the design principles identified throughout the study, while further refining these principles.

1. The first theme highlighted that students were using the mobile application, and that they felt it was effective for helping them learn. They were using it...
for troubleshooting technical issues and for knowledge extension, with the application providing a useful resource in both scenarios. This supported the design principle that on-demand resources should be mobile device compatible.

2. The second theme maintained that the layout of the application was simple and easy to use. There were no suggestions regarding how the layout could be improved, though some students suggested there was scope for making the application more engaging from a design aesthetic. The students felt that having a simple layout was important. The design principle that on-demand resources needed to be logical was repeated as a fundamental consideration.

3. The third theme identified that student developed content was viewed as something that could be valuable and engaging from a student perspective. The students felt that learning from their peers had potential to increase their confidence in the use of music technology. This was previously identified as a design principle, with the student focus group strengthening the suggestion that student developed content could be relevant to the design of on-demand learning.

4. The fourth theme developed the design principle that on-demand content should include more diversity. This could be facilitated through covering techniques that could improve student knowledge of popular music production techniques. While the focus on task-specific resources provided opportunities for students to have contextual learning opportunities during project work, there was also scope to facilitate knowledge extension through providing a wide diversity of resources.

5. The fifth theme suggests that resources need to be concise and cover ideas quickly. The students participating in the focus group felt that on-line tutorials often took too long to get to the point of the learning activity. Their suggestion was that tutorials needed to move on quickly, so that the learner can quickly find and apply the information.
6. The sixth theme reinforced the idea that resources should be visual. This could be in the form of video tutorials or images, dependent on the context of the information.

6.6 Refined Design Principles

The first design principle from this iteration of the research is that on-demand resources need to be diverse. Students acknowledged that while the existing content was relevant and useful, additional diversity in content could benefit the usability of the learning tool. The overarching suggestion was that more tutorials covering a range of production techniques would enhance the application. It was proposed that tutorials could extend into areas more advanced than previously covered. Suggestions for enhancing the video tutorial content included development in a number of areas. It was suggested during the focus group that tutorials covering specific tips and tricks related to music production would be useful. These tutorials could relate to a specific technique for improving vocal production, or for using specific audio plug-ins effectively. While this theme emerged as the perspective of a limited group of more advanced students, investigation of YouTube found that tutorials of this nature are commonly developed to support users of music technology. While many tutorials are already available through YouTube, contextualisation of software and hardware specifically found in the BPM studios would be beneficial. Through providing a local context that delivers highly relevant information, students are able to engage with learning in a context familiar to them.

The next design principle proposed was that on-demand resources needed to be concise to make them more engaging. The focus group participants suggested that tutorials needed to cover the main points quickly, then moving on. This would help students to engage with this information as required. It would also seek to minimise disruption of their workflow, working them through concepts as they emerged. On-demand learners have a limited amount of time to engage with learning. Resource design needs to reflect this by making resources concise.
During research iteration three the design principle that student-developed content was relevant was reinforced by students participating in the focus group. Incorporation of student on-demand resources, though not trialled during this project, requires further research, as suggestions are that students would engage with this approach to learning. Many students and staff within the BPM program indicated the importance of peer learning. This happens implicitly through the program design and could have potential in the digital realm as well. Many students engage with learning from their peers on demand through social media and in person. Literature also suggests that user-generated content is highly relevant to the development of on-line learning environments (Jenkins, 2006, 2009; Waldron, 2013a, 2013b). Ideas surrounding networked individualism have revealed the importance of our networked society, within which participants are active contributors to new media environments (Rainie & Wellman, 2012). Further research into the impact of student-developed content through this medium could be warranted, as indications are that this would increase student engagement.

Other design principles that developed from this research iteration related to offering an integrated approach to application design. Studio booking and fault reporting were included into the application design and many students engaged with these administrative tools. Because of the modular nature of the application development, the addition of services was integrated as web page links. This meant that navigation of these services could become problematic. Students suggested that seamless integration of the mobile application with other aspects of their digital learning resources would be beneficial. Development of an application that more effectively integrated with university services would be of benefit to the application’s usability. Budgetary reasons meant that this was not possible for this instance of the application’s development.

The final design principle was that resources needed to be regularly reviewed to establish their continued relevance to the user. The recording studio is a dynamic space with new music technology and techniques regularly being added. Other pieces of equipment quickly lose relevance. Students suggested during the survey that tutorials covering new
pieces of equipment would benefit their learning. Maintaining the relevance of resources through review would ensure that the on-demand learning resource continues to be useful to the users of the space.
Conclusions and Design Principles

7.1 Overview of the Study

This project investigated the identification of design principles for on-demand resources to support students learning popular music production. The research project was situated at the Queensland Conservatorium at Griffith University’s Gold Coast campus with students studying popular music. The students involved in this program of study regularly engage with music technology to record original music tracks as part of the program’s major study. Often, these students work in teams to complete their recording projects, working in a situation that “mirrors professional practice and utilises a practice-based and peer-reviewed learning framework that develops student understanding of associated technical and creative concepts” (Anthony, 2015, p. 140). While BPM students can focus on different aspects of the music production process, all students engage with music technology to some degree through their recording activities.

BPM students participate in coursework that supports their use of the recording studios and popular music production techniques. However, they often work in the recording studios outside of typical technical support business hours. During these sessions, BPM students experience regular issues with using these technologies, often when students are faced with unfamiliar hardware or software, or when they are using these music production tools in new contexts. Entering into this environment can also be challenging for new users, who are finding their way through the variety of hardware and software available to produce music. These issues do not end after the first year of study: The increasing complexity of equipment available to students as they progress can also cause confusion. This can lead some students to disengage with technical aspects of the popular music production process. Since many students work in teams to produce music, having a solid grasp of the
The availability of digital audio workstations (DAW) or audio recording software has seen the development of home recording set-ups as a viable alternative to professional studios (A. Bell, 2014). Musicians entering the industry need to be multi-skilled to prepare themselves for a portfolio career (Bartleet et al., 2012). The ability to frequently record and reflect on their work is also a valuable learning tool for musical development, and this is integral to the learning enabled by the major study program (Carey et al., 2006). Many graduates of the BPM program also engage with recording music as a means of paid employment after graduation.

This research project sought to identify design principles for developing on-demand learning resources to support students learning skills in popular music production. These learning tools were investigated through iterative cycles of research with a view to establishing a set of design principles for educative provisioning in this area. The literature reviewed in the field developed an argument that, based on the continued influence of technology in delivering learning opportunities, BPM students would engage with bespoke on-demand learning resources that supported their learning environment.

A major influence on student engagement is access to technology. Technology is impacting on how post-secondary education is being delivered. Education providers are actively seeking to incorporate more technology into teaching to enhance student engagement. Within the sector, an increasing emphasis is being placed on the relevance of mobile and blended learning models for supporting higher education (Adams Becker et al., 2017). This is impacting on student expectations regarding access to information, because using digital technologies to access information is part of daily life for these students (Bennett & Maton, 2010). Outside of formal education, vast stores of information are available on-demand, allowing mass engagement with informal learning through technology (Tozman, 2012). Because of these developments, formal education structures are evolving to incorporate more technology to keep abreast of these changes (Johnson et al., 2013). The
learning experience is changing for many students, as they are used to living a personalised learning journey through access to mobile technologies or other online forms of learning (Mundie & Hooper, 2014). Structured, freely available online coursework is another area that is influencing student expectations of information exchange. For example, MOOCs have seen the increasing availability of a free, quality education experience in the online world. This is also affecting higher education delivery models as providers seek to establish in what ways this will affect the area (Kiers, 2016).

Informal learning is commonly facilitated in the online environment through the exchange of information (Bernard et al, 2018; Cayari, 2015; Kruse & Veblen, 2012; O’Flynn, 2015; Salavuo, 2006, 2008; Waldron, 2011, 2013a, 2013b, 2016, 2018). In the world of music, many practitioners already engage with learning in this way. BPM music students regularly engage with exchanging information related to their musical activities through online environments, and student engagement with social media is widespread. The school Facebook page -- the BPM Noticeboard -- is an online space where BPM students, alumni, and staff exchange information related to a range of musical activities. The high level of engagement with these environments indicated that on-demand resources could engage these students through delivering learning opportunities when they needed them urgently.

Outside of formal education in music production, this on-demand method of learning technical skills is common amongst these users (Avid, 2017; Gearslutz, 2017). Music producers working in project studios often incorporate learning new skills and techniques into their workflow (Slater, 2016). Within the industry many developers share resource tutorials and support through online channels, making this form of information exchange standard practice (Avid, 2017; Pro-Tools-Expert, 2017). Within the BPM program, coursework in audio engineering and music production is delivered through face-to-face lectures and tutorials. Some online support is offered via the learning management system Blackboard, although this mainly supports the theoretical concepts covered during lectures. Before the development of these on-demand resources there were no specific online
resources to assist students with learning popular music production. Some studies have been conducted suggesting that learning technologies could be an effective form of support for students learning these skills (King & Vickers, 2007). While a range of relevant information already exists through the World Wide Web, students new to popular music production can take some time to develop the skills to find relevant and credible information. Often, the learning materials required are contextual to the equipment, software, and usage patterns employed in the BPM studios. This project investigated the design principles for on-demand delivery developed through offering these novices a scaffolded environment. It mirrors the processes of information exchange in the wider music technology community, leading students to develop their self-directed learning skills.

This research project established design principles for on-demand learning to support learning in this area. It did this through investigating some key research questions related to the delivery of on-demand education. The primary research question asked was:

What design principles should be employed in delivering on-demand resources to support students learning popular music production?

This was supported by a series of sub-research questions related to the use, structure, and delivery models. These questions were designed to inform the establishment of design principles for delivering on-demand resources:

1. In what ways are on-demand resources being utilised by students learning popular music production?
2. In what ways can on-demand resources be structured to deliver instruction in popular music production?
3. In what ways can on-demand resources be delivered to students learning skills in popular music production?

7.2 Research Iteration 1: Pilot Study

A pilot study investigating the design principles for supporting music technology education was conducted during 2015. The pilot study gathered information about whether
there was a need, or desire for students to engage with learning in this way. It was also conducted to establish some initial design principles for sharing on-demand resources (Voss, 2016). During this pilot study, resources were developed and shared with the student cohort. The resources focused on basic equipment operation and configuration, combined with recording techniques for a range of instruments, and at this early stage of the project focused on first year students and their needs because these students faced the steepest learning curve. The video tutorials were shared through a variety of methods including Blackboard, YouTube, Facebook, and Apple iBook.

Throughout the pilot study, surveys and focus groups were conducted with BPM students before and after the intervention. Initially, the research focussed on whether there was a need for students to be supported in this way, and whether they saw this as a delivery mode responsive to their needs. It was established that often students entered the program with limited prior experience in using a recording studio. These students also indicated that they were generally experiencing some issues with operating studio equipment and felt that on-demand resources could benefit their learning (Voss, 2016). Students were specifically asked at what point they felt they would access information related to using the recording studios. Overall, they indicated that they would primarily engage with this form of learning as required, reinforcing the hypothesis that on-demand education is a relevant delivery model in this context (see Figure 9). This outcome highlighted that students saw this form of learning as a support mechanism that was immediate and responsive to their learning context.

Through the pilot study a number of preliminary design principles were identified. These included the following design principles:

1. That on-demand education is delivered in a mobile device compatible format.
2. These resources should also focus on being task specific, visual, contextual, logical, engaging and differentiated.
3. Their role is to supplement existing learning activities.
4. Student-developed content could also be considered as a means of improving student engagement in the use of the resources.

The BPM students provided feedback that suggested that the development of a mobile phone application could be the most effective delivery strategy. Development of a mobile phone application that shared video content from YouTube would allow the video playlists categories to be managed externally and accessed in a variety of ways. Sharing resources in this form cuts down on management time, through uploading to a central repository for the video content. The use of modular elements is a recognised mobile learning design principle that has the potential to increase the capability of the application (Lecheler & Hosack, 2014).

Students offering their perspective on the types of resources they considered would be beneficial suggested that one of the primary functions of these resources was to cover trouble-shooting scenarios and basic set-up procedures. Such resources, they thought, would benefit them by assisting them to learn about popular music production through a range of task-specific tutorials. These tutorials should focus on providing visual demonstration of these tasks. However, the context of the topic should also be considered. The key was to provide resources that conveyed the message quickly. Therefore other forms of information should be considered, dependent on the context. These resources need to be logically grouped into relevant themes or scenarios to allow students to quickly find relevant information. An example of this could be the grouping of information related to a particular piece of equipment or a commonly experienced issue.

It was also suggested that on-demand resources needed to be engaging for a contemporary audience, through mirroring production standards of digital learning environments outside of formal education. These resources needed to be differentiated and cater for different ability groups as a supplement to their education. There were some suggestions that student-developed content should be included, as this had the potential to engage students in the learning environment.
7.3 Research Iteration 2: Mobile Application Development

In response to the pilot study the development of a mobile phone application commenced early in 2016. Based on the student response to surveys where they indicated their preference for using mobile devices, a mobile phone application -- BPM Studios -- was developed using the mobile application builder Appy Pie. The focus of the application was to provide a modular, on-demand learning tool that BPM students could download as an easy access point for the YouTube tutorials created to support use of the conservatorium studios. Other services were also incorporated into the design, including access points for the BPM Studios Facebook page, fault reporting, studio booking, and a range of other university services.

During this iteration of the research, expansion of the available resources was continued to incorporate more diversity in the on-demand resources. This included more task-specific and supplementary resources applicable to students from across the program. Once development of the mobile phone application was completed it was shared with a select group of students and staff for feedback. This iteration of the research process was conducted to refine the layout of the mobile phone application prior to release to the digital download stores. The layout of the application was created based on the design principles identified during the pilot study; that is, the layout needed to be logical, well-structured, and differentiated to make information easy to find. The focus group participants made some suggestions to improve aspects of the application’s layout to enhance the logical flow of information.

These modifications incorporated a range of minor amendments to improve the overall layout and functionality of the mobile phone application, including:

- Moving to a simple **text-based layout** to improve clarity of information flow
- The addition of a **frequently asked questions playlist** category to help students with finding troubleshooting tutorials quickly; and
Ensuring that the application was focussed in its purpose; this involved the removal of some social media links within the phone application.

7.4 Mobile Application Delivery

Following the initial testing of the mobile phone application it was uploaded for digital distribution. Students indicated they had engaged with downloading the learning tool during lectures, and research was conducted with the student cohort to assess how the initial delivery of the phone application was received. This research also sought to further refine the design principles related to delivering on-demand information. Student surveys and focus groups established that the BPM students were using the application to assist them with their recording activities. The usage patterns established implied that students were using the resource in the following ways:

- To troubleshoot and to assist with basic set-up procedures and unfamiliar situations while using the studios; and
- For administrative processes, including studio booking, fault reporting, and accessing other Griffith services.

Overall, the students felt that the layout was appropriate to their needs. One of the initial design principles was that on-demand resources should be carefully structured, logical/intuitive, and freely accessible. Banga and Weinhold (2014) recommend that mobile applications need to be simple to navigate, otherwise users will lose interest. Before the release of the BPM Studios application, testing was conducted to refine the layout with a focus group. After the release to the cohort there were some suggestions to improve the functionality of the phone application as a learning tool. This included the following recommendations, which added to the existing design principles identified through the pilot study:

- Integrated: extensive integration of the phone application with university services is needed, to deliver centralised services that would assist students with other aspect of the university experience. For example the integration of the BOPMAT assessment
interface so that students can listen to portfolio submissions, while using mobile
devices more easily. Other suggestions included more seamless integration of
equipment and space booking tools.

- Diverse: the inclusion of more advanced content to cater to more advanced students
  would be beneficial. Consideration also needs to be given to the learning needs of
  students working within other genre that use a range of different popular music
  production techniques.

- Concise: resources need to be relatively short and be able to cover concepts quickly
  to make the content more engaging for the intended audience. On-demand learning
  means that users have limited time to engage with learning and design needs to
  reflect this.

- Reviewed: On-demand resources need to be regularly reviewed to establish their
  continued relevance to the users (see Figure 18).

![Figure 18. Emerging design principles.](image)

### 7.5 Conclusions

The purpose of this research project has been to establish a set of design principles
related to on-demand resources for students learning popular music production. However, it
also sought to ascertain whether it was relevant to support students learning skills in popular
THE DESIGN PRINCIPLES OF ON-DEMAND LEARNING: A DESIGN-BASED RESEARCH STUDY OF EDUCATIVE PROVISIONING IN POPULAR MUSIC PRODUCTION

music production with on-demand resources. There are a number of factors that suggest that educative provisioning in developing skills in popular music production with on-demand resources is relevant. Musicians often engage with informal learning to develop their skills (Green, 2001). Often they also engage with learning skills related to popular music production while in the process of creating (Slater, 2016). Technology has been trialled in the past to assist students with engaging in learning these skills (King, 2009). BPM students often enrol with limited prior experience in popular music production or in operating music technology. This has meant that often these students experience technical difficulties while learning to use the wide range of music production tools available to them.

Many students who participated in the surveys and focus groups conducted during this project indicated that they felt on-demand delivery was highly relevant to their needs. BPM academic staff also indicated that on-demand delivery could provide effective support for education in popular music production. The demonstrated student engagement with using the resources also indicated that on-demand resources were proving to be a useful support for their learning activities. Expanding the available base of on-demand resources could have an impact on learning outcomes. Offering BPM students learning opportunities through on-demand resources supports learning through catering for learners in a way that mimics the learning patterns of popular musicians and music producers: facilitating student learning in context while creating is engaging for them.

On-demand resources support their busy working methods, where learning technical skills becomes part of the process of popular music production. It is often the case that music producers learn skills as they experiment with the development of techniques (Slater, 2016). Popular music education mirrors the natural learning approach of popular musicians, who are largely self-directed learners outside of formal education (Green, 2001). Developing a learning environment that offers on-demand support in this way, mirrors how users outside the university environment engage with learning these skills (Pro-Tools-Expert, 2017).

The overarching research question of this project asked what design principles should be employed in delivering on-demand resources to support students learning popular music
production. This was then broken into sub-questions to deliver a perspective on the various aspects of this question. The first of these sub-questions asked, in what ways can on-demand resources be delivered to students learning skills in popular music production? This project investigated many delivery methods before settling on the use of a mobile phone application to deliver the on-demand information. This evolved the first design principle, which is that on-demand resources should be mobile device compatible. Many students indicated during the pilot study that accessing tutorials through a laptop or mobile phone was their preferred delivery method (see Figure 10). The project trialled delivery through Apple iBook, though engagement with this format was more limited than expected. Similarly, student responses suggested that engagement with using the resources through the learning management system Blackboard was not a preferred option (see Figure 10). Because of the responsive nature of the on-demand learning required by these students, access via Blackboard was more prohibitive. Possibly this was because of the structured, linear nature of the resources available through Blackboard coursework. There is also the added inconvenience of having to log in to the learning management system, slowing down the learning process.

On-demand learning resources need to be responsive and accessible to engage users, because of the context in which they engage in using them. This design principle became evident through this research project, but is also noted as a principle of mobile learning (Gu et al., 2011). Mobile learning opportunities need to be responsive to learners who utilise these resources while working in other contexts (Gu et al., 2011). This research demonstrated that on-demand access through the mobile application was the most efficient way of delivering resources to support students’ learning. The mobile phone application in this project used playlists from the project YouTube channel to distribute content. This was found to be an effective and time-efficient way of managing content. Lecheler and Hosack (2014) also recommend modularity as a mobile application design principle because of the increased capability of the mobile application.

The second sub-research question asked in what ways are on-demand resources being utilised by students learning popular music production. Often, the BPM students involved in
the study identified that they were engaging in on-demand learning to troubleshoot or assist them with learning basic set-up procedures. The responsive nature of engaging with this type of information highlights that on-demand delivery is relevant to the needs of these students, since they were using the resources as intended: as a virtual technical support tool designed to reinforce their project work activities. The second design principle identified was that on-demand resources needed to be task-specific in their focus. It would often be the case that the student had a task-specific question to answer, and the resource tutorials provided solutions to these commonly experienced issues. There are many examples of these types of situation. Some students lacked familiarity with setting up the headphone configuration in the recording studios; the research identified that the mobile phone application meant that students could easily refer to a tutorial to assist them with this basic set-up procedure. Other scenarios involved the mobile application assisting students with configuring software to make the studio “work” when lack of understanding in this area became a factor.

The research also highlighted that, when required, the mobile application provided an overview of various pieces of analogue hardware available in the recording studios. This provided supplementary information that assisted with learning how to use individual techniques or equipment on demand. Students were using the phone application to learn the operation procedures for complex pieces of music technology like the Solid State Logic AWS900 DAW controller. The learning tool enabled them to configure the desk for a variety of recording scenarios, while gaining a better understanding of the basic set-up of this piece of equipment. Students also identified during the research that they were using the mobile phone application to familiarise themselves with the audio pre-amplifiers and compressors available in the recording studios. Other ways that students utilised the mobile phone application involved gaining a better understanding of music production processes. Examples given of this involved students new to recording using the application to gain a better understanding of microphone placement for recording instruments. The common thread was that all of these situations supported students to learn in context, while working on their portfolio recordings.
The complexity of the technical processes involved in producing music means that what needs to be learnt is often not apparent until the process needs to be applied. While this can be true for experts who are using new pieces of technology, it is even more the case for new users who have so much more to learn, so on-demand education is a vital tool for getting the job done. When presented with the opportunity to engage with this form of contextual learning, many BPM students engaged naturally with this form of learning support. This indicates that on-demand resource design needs to anticipate the needs of the user through identifying skills in popular music production that will be relevant to the intended audience. This is a key design consideration for delivering on-demand resources.

The final research sub-question asked in what ways can on-demand resources be structured to deliver instruction in popular music production. This question forms the basis of the design principles for this type of learning environment. The fourth design principle suggests on-demand resources need to be contextual. The primary way of delivering information during this project was through the use of video tutorials to cover the technical information required. However, the use of some other forms of information could be more relevant in other contexts. For example, the use of images as a form of on-demand information is a design idea that emerged during the research. One context where this would be a useful on-demand information tool would be for demonstrating techniques for recording instruments. An image that shows the placement of microphones for recording acoustic guitar is one example where this could give learners a shorter, more succinct resource for learning popular music production techniques.

Other documents were included in the on-demand resource delivery during the project, but indications were that these were not heavily utilised. Some students had suggested during the pilot study that PDF documents could be an effective way of delivering some forms of troubleshooting information. This was trialled, but response to this form of information delivery structure did not meet initial expectations. There are some contexts when PDF could be useful; consequently, it is a design aspect that requires further research and could be potentially applicable for some contexts. Gu et al. (2011) recommend that
because mobile learners are using applications to quickly access information while on the move, then learning objects should be bite-sized pieces of information. Therefore, on-demand resource designers need to strongly consider the context of information and deliver the information in the most succinct way possible.

In the recording studio environment, students need to respond to situations that occur spontaneously through their interaction with the equipment. Because of the creative workflow, technical considerations need to be dealt with quickly so as not to disrupt creativity. Often the discovery and development of working practices is part of the process of creation and experimentation. Therefore, one of the main design principles relates to how on-demand tutorials are grouped, in order to provide information that is accessible and responsive. The fifth design principle is that on-demand resources need to be logical in their structure. Resources for students in these contexts must be grouped appropriately, giving them easily accessible and systematic approaches to finding relevant information. Resources should be grouped according to ability levels and related to the various stages of the program, topic, range of frequently asked questions, or commonly experienced problems that students face in the studio. Some of the initial design principles developed suggested that on-demand resources should be associated with locations and be well structured, logical, and accessible. Search ability was another element of design that should be taken into consideration. The on-demand resource ideally needs to be able to facilitate student searching to accommodate their immediate needs.

Similarly, when using video tutorials, producers and presenters of on-demand resources need to assess how to quickly address the topic. Largely, the resources created in this project were video based. Feedback on these tutorials demonstrated that to be useful on-demand resources they need to be short and engaging. Therefore the sixth design principle suggests that resources needed to be concise. While using video resources in this learning context, extensive explanations or lengthy monologues do not engage with the key principle of on-demand education which is to deliver useful information quickly, allowing the learner to move on with their workflow. Providing on-demand resources that are edited to cover key
concepts in a way that is efficient is more relevant in the context in which these resources are being used. This theme has been apparent throughout the research project, and was identified as a key design principle during the student focus groups, where the idea was discussed at length. This design principle is also apparent when looking at how the general public have engaged with using the on-demand resources overall. The project’s YouTube channel demonstrates that the average engagement with watching this form of instruction falls in the vicinity of two minutes.

There are other forms of tutorials that students felt would be relevant to their needs. Once again the research highlighted the importance of the speed of information available to the learner. The students participating in focus groups nominated that quick tips and techniques is an area to explore and develop, as engagement with this kind of information can be quickly used to up-skill students with various techniques. These tips and tricks could either be software or hardware based. The idea of these kinds of resources is to present a key understanding or technique that could benefit a student. For example, explanations of the key principles of parallel compression (a commonly used audio processing technique) could improve student audio mix outcomes. While there are many video resources that would explain this particular technique available via online search engines, the use of the resources available within their working environment would make it more relevant to the student. This would potentially allow the student to develop their understanding of the concept, giving them the ability to translate it to other environments. There are also some aspects of audio hardware (as opposed to software) that could fall into this category. In this case, the contextualisation of localised resources available where the students are working could provide insights into “making it work” in the studio.

Other design principles that could be highly relevant to the provision of on-demand learning tools include the addition of student-driven tutorial content. There is evidence to suggest that the inclusion of a peer learning perspective in the on-demand environment could help to develop student engagement. Students have identified through much of the research that they often engage in learning through their peers. This happens face-to-face and often
through social media. Staff also identified that peer learning is an important part of the BPM program’s pedagogical foundation, with students often working in teams to learn and complete projects. With an emphasis on informality, the peer learning aspect of the creation of an effective on-demand learning environment is not to be underestimated. Many students have identified that this is one of their preferred learning processes, so development of this aspect of the delivery of an on-demand learning environment could assist with enhancing student engagement in learning. There are a number of reasons that this could work effectively and provide many benefits to the students.

- Personal connection with the student delivering content means that students want to support and engage with learning from this person. This was identified during the research as something that is important to the student. Because they know the person, they feel a connection and increased confidence in their own ability to master the concept or skill.

Although this aspect of the development of on-demand resources was not explicitly researched, there are strong indications that this could work. Further research is recommended to investigate the potential impact of the inclusion of peer learning into the on-demand learning environment.

It was also recognised during the research that many students were using this learning tool to assist with administration of their daily activities. This could include booking studio space and equipment, reporting equipment faults, signing in guests, and other activities related to portfolio recordings. Because of the way that the BPM Studios mobile application was constructed, many of these services were attached as web links to external sites. The mobile application could benefit with tighter integration with these services to serve student needs. Some students expressed that the integration of assessment tools like the program’s BOPMAT, used for assessing portfolio submissions, would allow students to easily study and engage with assessment processes and other activities while on the move. The busy lifestyle of many students means that often they are engaging in learning in segments, often supported by whatever electronic device they have at hand. Universities are increasingly
aware that this is how students are engaging with accessing information. Funding models need to begin supporting the expansion of mobile delivery to allow students to learn, manage, and reflect on their work while on the move. Teaching staff can enhance student engagement through supporting the flexibility of student learning by creating a multitude of learning opportunities.

The development of resources to service the need of these users is something that needs to be constantly updated and refined. The nature of technological development means that facilitators of these environments need to be receiving feedback from students, teachers, industry experts, and other recognised authorities regarding new content. Review of materials needs to be ongoing so as to keep the learning environment relevant and useful to the student cohort. Without processes in place to ensure that content remains relevant, it is easy for learning environments such as these to become redundant.

7.6 Conclusive Design Principles

Based on all of the research conducted, a set of final design principles was developed. These design principles were based around the fundamental principle of mobile device compatible delivery (see Figure 19). The conclusive design principles that emerged from the project are:

**Mobile device compatible:** That on-demand resources should be delivered via mobile devices to increase accessibility for students seeking to engage with on-demand learning. The use of a mobile phone application to facilitate delivery of these resources provides students with the most immediate way to engage with on-demand tutorials. Students identified during research iteration 1: the pilot study that using mobile devices was their preferred delivery method. This theme continued throughout research iteration two and three, where students continued to support the idea of engaging with on-demand learning through mobile devices. Mobile learning has been
THE DESIGN PRINCIPLES OF ON-DEMAND LEARNING: A DESIGN-BASED RESEARCH STUDY OF EDUCATIVE PROVISIONING IN POPULAR MUSIC PRODUCTION

recognised as a learning resource that can have an applicable context in music education (Chen, 2015; Wallerstedt & Hillman, 2015). Technology forecasters have proposed that mobile learning is continuing to grow in relevance to higher education, through enabling learners to engage with building their skills wherever they are (NMC, 2017).

**Task-specific:** That on-demand resources should be task specific in their focus. This can be achieved through providing demonstrations related to troubleshooting and basic set-up procedures for the skills involved in popular music production. This design principle recommends that on-demand resources need to support students through commonly experienced issues and unfamiliar situations. The theme of troubleshooting and technical support for student popular music production activities was apparent throughout all stages of the study. Data collected through the student surveys and focus groups highlighted that students saw task-specific support as the primary function of on-demand resources. Gu et al (2011) propose that mobile learning opportunities need to be practical, while fitting within a useable context. Maintaining a significant focus on task-specific information within on-demand learning resource design, offers practical solutions for the intended user group.

**Visual:** That on-demand resources should be visual as a fundamental design principle. This can be in the form of video tutorials to demonstrate the use of music technology equipment or application of popular music production techniques. The theme of visual demonstrations emerged strongly from the staff interviews conducted during the pilot study. Lechler and Hosack (2014) advise that the use of visual information on mobile devices assists with user interaction by communicating information in a more effective way. The use of images also has the potential for sharing on-demand information,
depending on the type of information to be conveyed. This theme was identified during a student focus group.

**Contextual:** That on-demand resources should consider the context of the on-demand information and, where appropriate, other forms of information delivery should be considered. Examples of this could be the use of images over video content when images can convey the message more efficiently. There are also situations where instruction lists, could assist with troubleshooting through providing a list of instructions. Students during a focus group recommended this. The need for applications to be contextual is also a recognised mobile learning design principle. Banga and Weinhold (2014) maintain the need for mobile designers to consider the context that requires the application to be used.

**Logical:** That on-demand resources need to be grouped appropriately to make the information easily identifiable. To facilitate this, on-demand resources should be associated with locations, tasks, or types of equipment. This will accelerate searching for information, improving potential response times associated with on-demand learning. This design principle during the academic staff interviews, and was supported by students participating in the focus group. It also demonstrates relevance to mobile application design principles, which suggest the importance of making applications easy to use (Banga & Weinholdt, 2014). This increases user engagement.

**Engaging:** That on-demand resources should be engaging to use and should appeal to a contemporary audience. They should do this through offering professionally produced content that appeals to the student demographic, through modelling aspects of social media environments. This theme was discussed during the academic staff interviews. Identifying the design characteristics of popular mobile applications is often used to inform design of mobile applications (Banga & Weinholdt, 2014).
Differentiated: That on-demand resources should be differentiated and consider student diversity in skill level and genre. These resources need to accommodate the needs of students from across the program of study. They also need to consider the needs of students working within other musical genres where production techniques can vary. Anticipating the needs of users and how they will interact with the mobile application is relevant to design (Banga & Weinholdt, 2014; Lechler & Hosack, 2014). This was recognised through the student surveys conducted during the pilot study. It was also highlighted by the academic staff, who recognised the diversity of students within the program.

Supplementary: That on-demand resources need to be designed as a supplement to a range of primary education activities. They need to complement and support the other learning activities through providing learning opportunities for students using music technology. Academic staff acknowledged the role of on-demand resources in supporting student learning of popular music production. While students engaged in on-demand learning when looking for task-specific information, the focus group participants also suggested that they were using the resources to extend their knowledge of popular music production techniques.

Student-Driven Content: That on-demand resources should incorporate student-developed content where possible. This could be incorporated through sharing student demonstrations in the use or application of music technology equipment or popular music production techniques. This theme emerged through the student focus group conducted at the conclusion of the project. On-line communities of learning have also had a recognised impact on the area of music. This is beginning to influence music education, due to the high level of engagement exhibited by on-line communities outside of
formal education. The development of student-driven content has the potential to increase engagement in the use of on-demand resources.

14**Integrated:** That on-demand resources should ideally provide integration of the phone application with university services, to deliver centralised services that would assist students with other aspect of the university experience. Within the context of the BPM program this would include the integration of the BOPMAT assessment interface so that students can listen to portfolio submissions, while using mobile devices more easily. Students also suggested including more unified integration of equipment and space booking tools.

**Diverse:** That on-demand resources should further to differentiating content, recognise the diversity of student experience levels and individual musical style. This could take the form of incorporating the inclusion of more advanced content to cater to more advanced students. The on-demand resources need to cater for the needs of students from across the program. Consideration should also be given to the learning needs of students working within other genres that often use a range of different popular music production techniques. An example of this would be inclusion of resources that cover electronic music production technique, which has a different focus to the genres of rock or country.

**Concise:** That on-demand resources need to be short and be able to cover concepts quickly to make the content more engaging for the intended audience. On-demand learning means that users have limited time to engage with learning and design needs to reflect this situation. Students suggested throughout the study the importance of being able to pick up a skill and engage with it quickly. Gu et al (2011) highlight the need for mobile

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learning opportunities to fit into usable timeframe, as this is a standards pattern of interaction of mobile learning users.

**Reviewed:** That on-demand resources need to be regularly reviewed to establish that they have continued relevance to users. Ongoing research into relevant material will support and enhance the student experience. The regular movement of technology, working methods and resources needs to be recognised. On-demand learning opportunities need to be relevant to the audience. Regularly reviewing content will facilitate the removal of irrelevant content, keeping the learning environment fresh.

*Figure 19. Mobile on-demand design principles.*
7.7 Key Understandings

Access to on-demand resources means that the potential of education is available around the clock (Tozman, 2012). This study has not set out to prove that on-demand education is more effective than other forms of education, but rather seeks to establish design principles for delivering education effectively in this form. During this study, many students indicated they are supportive of the idea. Though how do educators facilitate student engagement with on-demand learning?

Many students are distracted by other creative pursuits within the BPM program. Proficiency in the use of music technology remains elusive for some of them. The themes emerging from the study suggest that the more accessible on-demand resources are the more likely students are to use them. Students identified through the research that they were using the mobile phone application. They noted that they were often using it to learn about basic set-up procedures or to troubleshoot while engaging in popular music production. The research suggested that the most convenient piece of technology they used, was the most favoured to deliver the information. Themes relating to the logical, task-specific, concise and differentiated design of resources; highlight that facilitating effective information flow remains a key understanding of designing on-demand learning support.

Challenges exist with enhancing student engagement with the use of on-demand resources. One of the primary challenges experienced during this project was maintaining an awareness of their availability. Providing students with visual reminders of the availability of the mobile phone or other on-demand delivery methods could potentially increase engagement with these learning tools. Possible ways of doing this could include the addition of this on the desktop display of computers, posters, regular promotion via social media, and other targeted promotional campaigns. Through promotion of awareness, students are more likely to turn to these resources, as they need them.

Other challenges involve building a learning culture where students engage with on-demand learning instinctively. Building an environment where on-demand learning tools become highly relevant to student needs takes time to develop. Academic staff should foster
the continued development of the self-directed learning skills of students through scaffolding these learning activities. Students need to be explicitly guided, particularly in the early days of the program, so they are aware of the resources and where to find the information they need. Only then will the development of these skills become embedded in the program and learning culture.

Students who do well are highly motivated and already have key skills in self-directed learning. While it is possible to provide students with the ways and means of learning, they cannot be forced to engage in learning. So initiating environments that enhance relevant learning for students and that assist them with the development of their own self-directed learning skills can be holistically beneficial to these students as learners. Although many students focused on the area of music technology, often exhibit a high level of engagement with their own learning. It is important to recognise that students within BPM have different focuses and priorities when it comes to their engagement with music technology. Some students simply need to learn fundamental concepts and require assistance with getting their head around using particular pieces of equipment, while other students could benefit from coverage of advanced concepts. Catering for student diversity is important, and recognition of the changing needs of these students is also highly relevant. Because of the shifting developmental needs of these students, facilitators also need to be constantly reviewing on-demand resource requirements. This could be prompted by new equipment and software purchases, or by students expressing interest in emerging areas of music production.

The provision of on-demand resources has the potential to foster self-directed learning; through guiding students to these kinds of learning experiences, we develop their natural inquisitive nature and independent research skills. Potential integration of the mobile learning application into aspects of coursework could assist students to develop these key self-directed learning skills. For example, during tutorials students could be guided through the process of finding information and offered the opportunity to learn these skills under the guidance of the tutor. Through having this kind of personalised engagement with the available resources, students could begin to develop some more implicit skills in self-
directed learning and independent research. Providing students with highly contextualised digital resources, the path to relevant and precise information can be made more attractive.

Students involved in this research project felt that the incorporation of on-demand, online resource materials helped them to learn concepts more effectively. They were able to review materials in their own time, and often preview these ahead of time, allowing them to engage with a topic and then seek to refine their ideas during the workshops. This allowed them to ask questions of the lecturer. This is important for a potential restructuring and development of a model for teaching in this area. Teaching music technology is highly reliant on a range of equipment and often there is not enough equipment to go around, so spreading resources amongst a range of students is important for ensuring equitable access to learning. When teaching in this subject area, a potential halving of the face-to-face project work, supplemented with the use of on-demand, online resources, could provide a more efficient means of transferring and applying the procedural information. Students would then have the opportunity to immerse themselves in richer learning projects, while having the support of an environment that delivers the technical information when needed, relevant, and required. Previewing materials allows students to review and refine topics and their understanding level of these topics. It also gives them the opportunity to refresh their knowledge when required.

One of the major issues with the provision of on-demand information is the development of materials to support these learning environments. Often, the associated development of video content, mobile applications, learning modules, and associated delivery methods can be costly. It has been noted that academic staff lack the skills to develop these learning environments unsupported. The real strength of developing your own resources lies in the contextualisation of these learning tools. This means that students have a real connection with the presenters, the equipment, and the overall context that is being presented. It offers them a space where they can engage with asynchronously learned key concepts, in an environment where they can use these tools first hand. Social networking outside of post-secondary education has influenced the way that people engage with learning
A DESIGN-BASED RESEARCH STUDY OF EDUCATIVE PROVISIONING IN POPULAR MUSIC PRODUCTION (Jenkins, 2006; Jenkins, Clinton, Purshotma, Robison & Weigel, 2009; Waldron, 2013a, 2013b). Providing these learning tools within an education environment teaching popular music production, could offer an engaging alternative to support student learning. While this study did not look at learning outcomes, further research in this area could assess if the provision of on-demand resources improves student outcomes in learning concepts surrounding popular music production.
References


Kiers, J. (2016). MOOCs and the effect on the institution: Experiences in course design, delivery and evaluation; faculty development; unbundling and credits for MOOCs. Foro de Educación, 14(21), 133-149.


Appendix A: Pilot Study Thematic Analysis

Table A1. Pilot Study: Thematic Analysis of Open Question Responses

<table>
<thead>
<tr>
<th>Troubleshooting Theme</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Troubleshooting Theme</td>
<td>Information on what to do when settings have been changed, or equipment isn’t working as it usually does.</td>
</tr>
<tr>
<td></td>
<td>Problem solving methods from simple-advanced.</td>
</tr>
<tr>
<td></td>
<td>Learning how to troubleshoot the studios.</td>
</tr>
<tr>
<td></td>
<td>I believe that collating the most common studio issues, and then making some sort of page on either Facebook or blackboard with easy steps to follow would be great.</td>
</tr>
<tr>
<td></td>
<td>Troubleshooting issues.</td>
</tr>
<tr>
<td></td>
<td>Instructions on how to resolve issues that occur frequently in the studio.</td>
</tr>
<tr>
<td></td>
<td>Maybe some troubleshooting guides for when specific problems occur.</td>
</tr>
<tr>
<td></td>
<td>Troubleshooting videos.</td>
</tr>
<tr>
<td></td>
<td>Video tutorials on trouble shooting</td>
</tr>
<tr>
<td></td>
<td>What to check if Pro Tools isn’t recording. For example how to reset Pro Tools to studio D settings the settings have been fiddled with. The only reason I could record one day was because a third year came in and reset it to studio D, knowing this was really helpful.</td>
</tr>
<tr>
<td></td>
<td>A tutorial on how to trouble shoot for things that aren’t working in the studio, and what you can try to find what’s causing the problem.</td>
</tr>
<tr>
<td></td>
<td>Problem solving methods from simple-advanced.</td>
</tr>
</tbody>
</table>

| Basic Set-up Procedures                                    | Tutorial on how to utilise the SSL analogue desk in Studio A to its full potential.                                                                                                                                                  |
|                                                           | Tutorial videos and/or PDF documents with basic setup guides, basic EQ and compressor settings.                                                                                                                                   |
|                                                           | Pro Tools Shortcuts (would be handy to have a pro tools cheat sheet handed to us at the start of 1st year)                                                                                                                                 |
|                                                           | General microphone models and their uses (what instruments they’re best for).                                                                                                                                                        |
|                                                           | DAW desk operation manuals. Headphone Amp patching tutorial (including new headphone unit in studio A). I know a lot of these resources are already available, however a central hub (website/Facebook page/LAG Module) that has all this information collated and presented in a user friendly way could help a lot of students that are lacking basic studio knowledge. |
Studio specific information such as creating headphone sends.

Instructions on how to do things step by step. For example patching headphones in Studio B, as they are weirdly labelled.

Gear specific tutorials.

Tutorials on how to use the devices in the third post room e.g. French Connection Modular Synth, Virus and Voyager Synth racks, Maschine and Korg Drum pads etc.

How to patch correctly in all the different studios/post-production rooms.

How to set up all the different DAWs with your pre amp inputs.

How to get sound out of the midi keyboards.

SSL desk support - using the reverb console.

Headphone set up in Studio A.

Online tutorials on how to use studio equipment as well as how to use DAW's and plugins.

Tutorial on how to clean and prepare the tape machine in Studio A.

Tutorials on the more advanced outboard gear (specifically in studio A)

Control desk tutorial.

<table>
<thead>
<tr>
<th>Audio Mastering Tutorial</th>
<th>A detailed tutorial on Mastering outlining the entire process with some examples. Mastering tutorials.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Audio Mixing Tutorials</td>
<td>Mixing tutorials for different genres of music.</td>
</tr>
<tr>
<td></td>
<td>Mixing tutorials.</td>
</tr>
<tr>
<td></td>
<td>Video tutorials on mixing approaches.</td>
</tr>
<tr>
<td>Microphone Techniques</td>
<td>Studio tutorials on general microphone placements on different instruments.</td>
</tr>
<tr>
<td></td>
<td>Microphone techniques and tone/timbre setting of instruments.</td>
</tr>
<tr>
<td></td>
<td>Quick easy diagrams showing microphone placement options, gear configurations etc.</td>
</tr>
<tr>
<td></td>
<td>Further details which can be found in relation to these diagrams, that way you can do further research if you need/want to.</td>
</tr>
<tr>
<td></td>
<td>Various microphone/recording techniques.</td>
</tr>
<tr>
<td></td>
<td>Microphone techniques and creative use of outboard gear.</td>
</tr>
<tr>
<td>Knowledge Extension</td>
<td>Videos or texts on alternative/ unconventional methods used to record that may not be taught in lectures/ tutes.</td>
</tr>
<tr>
<td></td>
<td>FAQ's and Instructional Videos including links to videos/tutorials by professionals outside the conservatorium.</td>
</tr>
</tbody>
</table>
### Table A2. Pilot Study: Thematic Analysis of Focus Group Question 1

<table>
<thead>
<tr>
<th>Have you found learning to use a recording studio challenging?</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Challenging</strong></td>
<td></td>
</tr>
<tr>
<td>In first year it took me a while to get my head wrapped around things... There is a lot of information thrown at you in a short period of time.</td>
<td></td>
</tr>
<tr>
<td>Before this course I've had very minimal experience with studios and recording software and what not. The first few weeks of first semester were a little daunting, but I found myself slowly getting used to it.</td>
<td></td>
</tr>
<tr>
<td>I definitely wasn't confident, or capable coming into the course and it took me a long time to even get the basics down.</td>
<td></td>
</tr>
<tr>
<td>The fundamentals of learning how to use the pre amps and patch bays to get into Pro Tools has been easy to get used to, but learning how to use the software and C24 has sometimes been a problem if something has been changed.</td>
<td></td>
</tr>
<tr>
<td>As a not technically minded person who had never worked in a studio before I struggled a lot in first semester of first year, but definitely got the hang of it by second semester.</td>
<td></td>
</tr>
<tr>
<td><strong>Not Challenging</strong></td>
<td></td>
</tr>
<tr>
<td>I found the general operation of the studios pretty easy. Everything comes down to common sense unless of course there's an unexpected technical issue. Like most other people here learning the basics has been pretty straightforward. I felt pretty comfortable with getting sessions set up and signal flow pretty early on in first year, however it wasn't really until mid-late second year that it became a lot easier to deal with technical issues quickly without them affecting the session.</td>
<td></td>
</tr>
<tr>
<td>I've found the basics of the studio to be relatively easy so long as you think logically about the signal flow.</td>
<td></td>
</tr>
<tr>
<td>Learning all the basics was pretty straightforward and both listening in lectures and doing individual projects helped me to learn all the foundations to record.</td>
<td></td>
</tr>
</tbody>
</table>
### Table A3. Pilot Study: Thematic Analysis of Focus Group Question 2

<table>
<thead>
<tr>
<th>When have you learnt the most about using the recording studio? During class lectures or during project work?</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Project Work</strong></td>
</tr>
<tr>
<td>I think I’ve learned my most valuable lessons about the studio less-so from a technical perspective and more from hearing how the lecturing staff or any of the older students or alumni really think about the way they’re capturing a signal and what matters in a practical context.</td>
</tr>
<tr>
<td>Doing individual projects helped me to learn all the foundations to record. I’ve found you learn so much just by doing things yourself and get help when needed (through asking people / searching the internet).</td>
</tr>
<tr>
<td>I have definitely learned from both but I think I consolidate information better while working on projects because you get to put the knowledge into practice.</td>
</tr>
<tr>
<td>I have definitely had experiences where I come across issues in my own sessions that hadn’t been covered in class, and I have had to either figure out how to fix them myself, ask people around or through Facebook, or even just work around the issue if it couldn’t be fixed.</td>
</tr>
<tr>
<td>Lectures in first semester helped a little with the basic stuff but mostly just jumping in and having a go was the best thing.</td>
</tr>
<tr>
<td><strong>Class Work</strong></td>
</tr>
<tr>
<td>Tutorials have helped a lot this semester and these have answered any questions we have about learning certain aspects of the studio.</td>
</tr>
<tr>
<td>I feel that while in some classes I have missed a lot of content as I didn’t understand, I learnt a lot as class numbers dwindled during semester, as I could ask more questions and have a more hands on experience.</td>
</tr>
<tr>
<td>I’ve definitely benefited greatly from the class time working in the studios and this time has allowed me to gain enough knowledge to then go practice and cement those skills during other projects. I’ve found that I learn the most technically by getting involved in class projects and my own time in the studios simply allowed me to further develop that.</td>
</tr>
<tr>
<td>From both classroom and personal experiences I’d say that the thing we learnt about was the operation of the patch bays and pre-amps, but other than that the rest has been a self-taught hands on experience.</td>
</tr>
<tr>
<td>I think a lot of what helped was in tutorials, seeing the tools and shortcuts being used in a practical context as we were all recording our own songs and kind of being forced to do a bit of it of the stuff ourselves, like patching or running Pro Tools.</td>
</tr>
</tbody>
</table>
Table A4. Pilot Study: Thematic Analysis of Focus Group Question 3

<table>
<thead>
<tr>
<th>Do you think having access to on-demand resources would help you to learn some of the technical processes involved in popular music production?</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Troubleshooting</strong></td>
</tr>
<tr>
<td>I think having access to on-demand resources specifically regarding problem solving issues like the C24’s not interfacing with the system and all that kind of thing and also to do with what I’ve said earlier with the nitty gritty of the specialities of each unit and how they work would be totally invaluable.</td>
</tr>
<tr>
<td>I think having access to on-demand resources would be helpful for sure, I think a lot of what frustrated me in first year is I would know things to a certain point however if things went wrong I had no idea how to fix them.</td>
</tr>
<tr>
<td>I feel that having access to on-demand resources would have been extremely helpful, as it was often the little things that were tripping me up.</td>
</tr>
<tr>
<td>I think that on-demand resources would be an awesome idea for exactly those little mishaps like the desk not working and other weird things that you can’t get your head around.</td>
</tr>
<tr>
<td><strong>Basic Set-up</strong></td>
</tr>
<tr>
<td>I think having on-demand resources would be an awesome way to learn some of the technical processes!</td>
</tr>
<tr>
<td>I think being able to have access to a resource that will show the I/O paths and other settings that are needed to get signal into Pro Tools correctly.</td>
</tr>
<tr>
<td>The on-demand resources would help if you don’t pay attention in your lectures or think about things logically. I believe they would be more suited to very early first years that may take more time than others to pick up the skills and knowledge. If these resources went into more technical details I could easily see them being very helpful across all years and skill levels.</td>
</tr>
<tr>
<td>I think all the basic stuff is relatively straightforward and can be solved through trial and error/common sense. On-demand resources for more advanced studio techniques would be really helpful too.</td>
</tr>
<tr>
<td>The on-demand resources would be awesome for these situations in particular, where people may not have enough of an understanding of actually what is going wrong to troubleshoot. I feel like most of the issues, especially in first and second years, came down to changes in hardware and software settings (sometimes very minor). I think it would be important to place emphasis on how to ‘zero’ the studio and reset everything to standard settings before sessions to avoid anything like this interrupting the recording. Looking back on most of my issues they were almost always stemmed from a single setting being left that way from the previous session or I/O settings being messed up from moving sessions between different computers and PT systems.</td>
</tr>
<tr>
<td>Having on-demand resources would definitely be a big help in my opinion. For instances like when the desk is suddenly not working, how to get it running again. Or the process of using headphone sends in D and C, like having to turn off main to cue. And also how to reset the I/O setting when someone has changed them, or getting the HDX to work when the sound is coming from the computer instead of the monitors. Just little technical things that are skipped over in class.</td>
</tr>
</tbody>
</table>
### Appendix B: BPM Studios Thematic Analysis of Short Answer

Table B1. *BPM Studios: Thematic Analysis of Survey Short Answer Question 1*

<table>
<thead>
<tr>
<th>Theme</th>
<th>Student Response</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Task Specific</strong></td>
<td>To figure out the SSL desk in the studio.</td>
</tr>
<tr>
<td></td>
<td>When I'm trying to figure out how to set-up a session.</td>
</tr>
<tr>
<td></td>
<td>When I'm stumped in the studio and needing assistance with a particular device or technique.</td>
</tr>
<tr>
<td></td>
<td>I usually use it when I'm stuck in a situation in the studios, then I refer back to the videos in particular which are a big help.</td>
</tr>
<tr>
<td></td>
<td>To see if I can find help when troubleshooting in the studios, and for the guest sign in list.</td>
</tr>
<tr>
<td></td>
<td>If I'm having studio trouble and need to access one of the tutorial videos.</td>
</tr>
<tr>
<td></td>
<td>I use the mobile phone application mostly to look up tutorials for the studios and post rooms.</td>
</tr>
<tr>
<td></td>
<td>When I am in the studios and want to learn about a particular piece of gear I am unfamiliar with.</td>
</tr>
<tr>
<td></td>
<td>When there's something I'm not sure how to do in the studio.</td>
</tr>
<tr>
<td></td>
<td>To watch short tutorials on how some studio gear works in my time of need.</td>
</tr>
<tr>
<td></td>
<td>I use it for headphone tutorial videos too.</td>
</tr>
<tr>
<td></td>
<td>Whenever I get confused in the studios.</td>
</tr>
<tr>
<td></td>
<td>Late at night out of staffed hours when I am recording in the studios alone.</td>
</tr>
<tr>
<td></td>
<td>As a resource for problem solving.</td>
</tr>
<tr>
<td></td>
<td>Tutorials I access when I can't do something in the studio.</td>
</tr>
<tr>
<td></td>
<td>I use it at home when I need to learn a particular piece of equipment or just general browsing.</td>
</tr>
<tr>
<td></td>
<td>If I am confused with something.</td>
</tr>
</tbody>
</table>
Administrative Processes

To look up class schedules and check studio bookings.
When I need to book studio time or post rooms mostly.
To quickly access Web Checkout when I’m not at a computer
I personally have used the application to lodge gear repair forms, check my bookings,
I use the app when I want to book things using Web Checkout.
Whenever I need to book studio time.
Whenever I need to book a studio.
Mostly when I need to book studios and equipment, and occasionally for the other available information on the app.
To book studio time.
Booking studios/rooms/instruments/equipment.
Being able to log fault reports.
When I need to complete fault reports
To book studios/rooms
I mostly use the application to check my timetable and emails. I tend to use a laptop when it comes to learning course content etc. I also use the app to check my grades.

Not using the application

Not using it at the moment.
None of the time as I haven’t had any problems operating equipment.
### Table B2. BPM Studios: Thematic Analysis of Survey Short Answer Question 2

<table>
<thead>
<tr>
<th>Theme</th>
<th>Student Response</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Satisfied</strong></td>
<td>I think that the menu and everything is positioned well and is easy to use.</td>
</tr>
<tr>
<td></td>
<td>Not really sure. It's very functional as it is.</td>
</tr>
<tr>
<td></td>
<td>It's pretty helpful as it is.</td>
</tr>
<tr>
<td></td>
<td>Nothing at the moment. I think for what it is and how I use it, the structure is pretty good. Nothing immediately comes to mind that I would want to change.</td>
</tr>
<tr>
<td></td>
<td>I think the app currently is structured and has the correct interface for the purpose it serves. There is a way to easily find tutorials, web checkout and lodge forms for damaged gear.</td>
</tr>
<tr>
<td><strong>Design Improvements</strong></td>
<td>Not 100% sure, maybe a more user friendly interface.</td>
</tr>
<tr>
<td></td>
<td>I feel like the layout is a little confusing when first learning to use the app.</td>
</tr>
<tr>
<td></td>
<td>Design could be more attractive perhaps.</td>
</tr>
<tr>
<td></td>
<td>User interface could look nicer.</td>
</tr>
<tr>
<td><strong>Additional Content</strong></td>
<td>I think more advanced videos would be helpful. I also feel that making more people aware of the app with signage could help.</td>
</tr>
<tr>
<td></td>
<td>The structure and case of use is brilliant. Any improvements would be aesthetic! Other than that the addition of more studio tutorials would be great.</td>
</tr>
<tr>
<td></td>
<td>Iron out the bugs in the Web Checkout section of the app. More videos on the studio and gear.</td>
</tr>
<tr>
<td><strong>BoPMAT Access</strong></td>
<td>BoPMAT access via the app.</td>
</tr>
<tr>
<td></td>
<td>Being able to access BoPMAT would be great.</td>
</tr>
<tr>
<td></td>
<td>I would love a way to access BoPMAT on mobile.</td>
</tr>
<tr>
<td></td>
<td>I feel like it would be handy to be able to access BoPMAT via the phone app so people can listen to their panel, hot 100 or check their folio assessments are all good.</td>
</tr>
<tr>
<td><strong>Integrated Services Access</strong></td>
<td>I find it very frustrating when I have to constantly log in to my account on the app even if I have used it five minutes prior to logging in. A suggestion could be to make the app a one-time log in sort of thing. That way finding things in a rush becomes far quicker.</td>
</tr>
</tbody>
</table>
Perhaps if the app had a single sign on function then students wouldn’t have to log in to the Griffith site every time in the app.

**Other Suggestions**

- It could possible involve notifications whenever an update is happening or news updates of the studios.

- I think some typed help sheets (pdfs) would be good when I don’t have much data or phone battery to watch full videos.

- An option to view availability and book studios with their connected recording room at the same time would be great.

- Increased app speed from various category extensions.
Appendix C: Electronic Resources

The BPM Studios1 YouTube Channel can be found at the following location.

BPM Studios1 YouTube Channel

The BPM Studios mobile phone application can be downloaded from either the Apple iTunes or Google Play stores.

BPM Studios Apple iTunes

BPM Studios Google Play