University of Glasgow

1st Annual College of Medical, Veterinary and Life Sciences

Visualisation in Science Conference

5th April 2017

University of Glasgow

College of Medical, Veterinary & Life Sciences

Welcome to the first College of Medical, Veterinary and Life Sciences Visualisation in Science Conference

Digital technologies play a significant role in our daily lives, and our students are increasingly turning to digital resources for educational purposes. In addition to this, many staff and students across the entire College of Medical, Veterinary and Life Sciences have been involved in many exciting ventures using digital technologies.

This is the first ever College wide conference entitled Visualisation in Science. The purpose of this conference is to bring together all members of staff and students. We want to showcase and highlight all the fantastic research, scholarship and technology enhanced learning and teaching activities that are occurring regardless of job role or subject studied.

It has been an amazing eye-opener to receive so many submissions of abstracts for this conference, from both staff and students alike. This day will truly highlight the great scope that we, as a College have, regarding digital technologies in education, healthcare and scientific research.

Digital research and applied technologies really are at the forefront of our College activities, where we also have recently had our "Imaging, Innovation and Impact" Industry Day, with the opening of the new Imaging Centre of Excellence.

Today will showcase what all members of staff and students are currently investigating, designing and applying across the College. It is designed for us to see what we are all doing in the field of digital technologies applied to a variety of fields. Our talks range from Big Data, augmented reality, animations and e-tutorials, to blended learning, mobile technologies and clinical applications.

On behalf of the conference team, I hope you have a really enjoyable day, and thank you for all your interest, enthusiasm and contributions.

Dr Paul M. Rea
Senior Lecturer

Keynote Address

“The Evolution of Visualisation in Science”

Dr Paul Chapman, School of Simulation and Visualisation, The Glasgow School of Art

The rapid evolution of computer graphics, driven by new technologies like virtual reality, is enabling us to decipher and better understand large multi-dimensional datasets and provide new insight into complex data.
In this talk, I will chart the explosive growth of visualisation from early hand drawings to the latest interactive virtual reality experiences. By charting this journey we may uncover some strong clues as to where technology innovation might lead us in the next 10 years.

Conference Team

Conference Chair

Dr Paul M. Rea

Paul is a medically qualified clinical anatomist. His research encompasses two main areas – clinically applied anatomy and digital product development used in anatomical education and training.
He collaborates with numerous clinicians on projects which aim to improve surgical knowledge and understanding, leading to more effective education and training, for the benefit of the patient. In addition, he collaborates with leading digital specialists in developing education, training and simulation products designed to improve anatomical understanding using digital platforms.
Paul teaches across the medical, dental and science curricula using research informed and led pedagogical techniques in anatomical training, to enhance student learning and assessment.
He is involved in public engagement with external bodies, is a Government Licensed Teacher of Anatomy, a Senior Fellow of the Higher Education Academy, a Fellow of the Royal Society for the encouragement of Arts, Manufactures and Commerce, a Member of the Institute of Medical Illustrators and a Registered Medical Illustration Practitioner.

Organising Committee

Dr Ziad Al-Ani

Dr Al-Ani is a lecturer at Glasgow Dental Hospital and School. He was awarded his MSc in Prosthodontocis from Manchester University in 1999. In 2004 he was awarded his doctorate from the same University. He was appointed by Manchester University as Clinical Teacher in Restorative Dentistry in 2004 as well as a Research coordinator for the TMD clinic.
In 2006, he obtained MFDS from The Royal College of Surgeons, Edinburgh. In recognition of his teaching activities, he was awarded the status of Fellow of Higher Education Academy in 2010.

Dr Craig Daly

I have been studying the cardiovascular system for over 30 years. My particular interest is in the autonomic (nerve-mediated) control of arteries and veins and, in particular, the interactions between the various cells of the vascular wall. Recent work has focused on the role of fat which surrounds most of the blood vessels of the body. This perivascular fat is thought to contribute to the relationship between hypertension, obesity and diabetes. As a course coordinator (physiology) I have also become interested in the use of animation for teaching physiology. My novel approach is to combine 3D microscopy with Pixar-style animation software. The resulting animations are anatomically correct to within 0.1mm and are therefore not 'artists impressions' (unlike most physiology-based animations you will find on You-Tube).

Dr Aileen Linn

Dr Aileen Linn: I am a University Lecturer and E-learning Development Officer for the Undergraduate Medical School, with a keen interest in working in partnership with students to enhance engagement and active participation in learning. Recent projects I have been involved with include introducing recorded lectures to support the curriculum, working in partnership with students and Dr Rea to develop a series of Anatomy e-tutorials and working in collaboration within students to develop a positive digital identity.

Mr Robert McKerlie

Robert is a Lecturer and Technology Enhanced Learning and Teaching (TELT) Lead at Glasgow Dental School. His main scholarship focus is with fostering active student participation in learning and teaching developments including learning technologies. He lead a group investigating the utility of syndicated learning, work that was supported by a modest grant from the Learning and Teaching Development Fund (LTDF), University of Glasgow and published in the European Journal of Dental Education (1). He is the academic lead for the final year self-selected study module (SSM) in eLearning, providing an opportunity for students to develop online resources that will be embedded into the curriculum for future years. Robert is the recipient of two Teaching Excellence Awards by the university in 2012 for a Career Distinguished by Significant and Sustained Commitment to Excellence' and again in 2016 as a member of the TELT Team at the dental school.

(1) McKerlie, R.A., Cameron, D.A., Sherriff, A., and Bovill, C. (2012) Student perceptions of syndicate learning: tutor-less group work within an undergraduate dental curriculum. *European Journal of Dental Education*, 16(1), e122-e127.

Professor Jo-Anne Murray

My background is in providing strategic leadership in developing and implementing online distance education programmes, as well as overseeing PGT programmes generally. I have run online programmes, online CPD courses and massive open online courses (MOOCs) as well as teaching on UG/PG on-campus programmes. I have experience in leading the delivery of novel teaching approaches in both UG and PG teaching, on-campus and on-line, including the development of a virtual campus in Second Life, digital feedback approaches and mobile apps to assist students with their learning.

Timetable of Events

Time	Title of Talk
09:00-09:30	**REGISTRATION**
09:30-10:00	**Keynote Talk** The Evolution of Visualisation in Science *Dr Paul Chapman*
10:00-10:15	Using student-created digital content to develop critical analysis skills and enhance employability *Dr. Anna Nousek-McGregor*
10:15-10:30	The Application of Digital Pathology in Clinical and Research Situations *Ms Clare Orange*
10:30-10:45	Web-Based Tools For Integrative Analysis Of Pancreatic Cancer Data *Mr Derek W. Wright*
10:45-11:15	**COFFEE**
11:15-11:30	An E-Tutorial on the Arterial Supply of the Human Body *Mr Muhammad Patel*
11:30-11:45	Measurement Error Of Traditional Callipers Versus Digital Scanner Software To Analyse Orthodontic Study Models *Ms Michelle Chua*
11:45-12:00	Creation of Head Anatomy E-tutorial *Miss Sarah Musbahi*
12:00-12:15	Using Photogrammetry to Create an Anatomical Learning Aid *Miss Katrina Wesencraft*
12:15-12:30	Use of Modern 3D Graphical Plots in Complex Evidence Syntheses of Healthcare Interventions *Professor Alex Sutton*
12:30-14:00	**LUNCH**
14:00-14:15	Development of a Gastrointestinal E-Tutorial *Mr Joshua Howard-Taylor*
14:15-14:30	Blended Digital Learning – Future-Proof Platform for Molecular Pathology Training in Diagnosis and Research *Dr Tomoko Iwata*

14:30-14:45	Construction of Animations for Teaching and Learning *Dr Craig Daly*
14:45-15:00	Cognitive Loading of Animations for Teaching and Learning *Dr Dorothy Aidulis*
15:00-15:30	**COFFEE**
15:30-15:45	Routes to augmented reality visualisation within CMVLS *Mr Neil McDonnell*
15:45-16:00	Digital mobile technology supporting student learning *Dr Nicola Veitch*
16:00	**CLOSE**

Visualisation in Science Conference

2017

Abstracts

Abstracts

Using student-created digital content to develop critical analysis skills and enhance employability

Dr Anna McGregor
School of Life Sciences

Critical analysis and interpretation of scientific literature are key transferable skills emphasised within many undergraduate degree programmes, as shown by their inclusion in university Graduate Attributes. Traditional teaching of these skills consists of small discussion or tutorial groups that individually read and then collectively analyse a published piece of work, which frequently yields unequal engagement across individuals and differing levels of skill attainment. This work investigates whether self-directed active learning during a field course can improve learning of being effective communicators, independent critical thinkers and reflective learners.

During the 2014 Marine Biology residential field course held at FSC Millport, third-year University of Glasgow undergraduate students were asked to create an 8-minute video that visually portrayed a published scientific study using their own mobile phones, iPads and cameras. In this way, students were required to read the article, critically analyse it to determine the main message and key results and then interpret those into a multimedia format. In order to create the video itself, students practiced skills in digital literacy and communication through novel formats. Overall, students were much more engaged with the exercise than with traditional critical analysis work, even contributing time outside their coursework to the assignment. Although the quality of the videos differed, all demonstrated in-depth reflection on the scientific messages illustrated and all expressed very positive feedback about this exercise. In conclusion, this exercise simultaneously developed a considerable number of transferable skills in a fun and creative way that could be easily applied to other scientific disciplines.

The Application of Digital Pathology in Clinical and Research Situations

Ms Clare Orange
MVLS/School of Medicine/Academic Unit of Medical Genetics and Clinical Pathology

Our academic pathology unit comprises academic, clinical and scientific staff from the college of Medical, Veterinary and Life Sciences, Institute of Infection, Immunity and Inflammation and the Institute of Cancer Sciences. With close links to our NHSGGC Pathology Department and Biorepository colleagues we provide a comprehensive range of services and support for tissue-based research.

We have a high-throughput autostainer for immunohistochemistry, laser microdissection and tissue microarray facilities. In addition to these validation technologies we also have a high-resolution digital pathology slide scanner and software which facilitates interpretation and analysis of data. Our aim is to provide expert research support, guidance and service to colleagues within Glasgow University and external collaborators.

Our digital pathology system comprises a high through-put slide scanner (Hamamatsu NDP) and software that can generate images up to 40x resolution. We also have IHC and fluorescence image analysis and interpretation modules (Leica Microsystems and PathXL) which can be applied to digitized whole slide and TMA images.

In modern research, digital pathology needs to reflect the broad spectrum of data modalities that underpin tissue-based research and cellular biomarker discovery. This includes epidemiological, clinical, pathology biomarker and molecular data, as well as the large digital images that capture the wealth of morphological information that tissue samples contain.

The use of digital pathology in MSc and other virtual pathology learning courses allow student-tutor interaction across multi-platforms at any time. It provides users with an interactive experience, by supporting the course creators and allowing them to add multimedia material such as sound, documents, and video content.

Web-Based Tools For Integrative Analysis Of Pancreatic Cancer Data

Mr Derek W. Wright
Rosanna Upstill-Goddard, Kamna Ramakrishnan, Craig Nourse, Andrew V. Biankin, Peter Bailey
Wolfson Wohl Cancer Research Institute

Summary: Personalised medicine is of increasing importance in cancer treatment. Wet-lab scientists are empowered by informatics tools to perform their own analyses and clinicians are guided in making therapeutic recommendations.

We present a suite of web applications, developed for the PRECISION-Panc initiative, to provide integrative analyses of genomic and transcriptomic data from patient primary samples, cell lines and xenografts, as well as clinical data on patient survival.

We have developed 3 web applications so far. *Gene Variants* enables browsing of genomic sequence data for Single Nucleotide Variations, Structural Variations and Copy Number Variations, with a focus on key mutations. *Pathway Analysis* provides visualisation of pathway activity variation in gene expression data. *Survival* generates Kaplan-Meier survival plots, stratified by gene expression and classification of carcinoma subtype. Summary reports are produced for clinicians.

Initial datasets were derived from the Australian Pancreatic Cancer Genome Initiative (APGI) and new data from PRECISION-Panc will be added when generated. We have deployed these apps utilising pancreatic cancer datasets; functionality is not restricted to pancreatic cancer and can be adapted with minimum effort to analyse other cancer types.

Implementation: R is a statistical programming language that is popular in bioinformatics for performing analyses of genomic and clinical data. Shiny is a web application framework for R that enables bioinformaticians to turn analysis scripts into interactive, browser-based apps. These apps have been implemented using R/Shiny.

An E-Tutorial on the Arterial Supply of the Human Body

Mr Muhammad Patel
Sarah Nichol
Undergraduate Medical School

As part of our Year 2 Student Selected Component, we created an e-tutorial on the Arteries of the Human Body. The E-Tutorial was created using Adobe Captivate 9 and covered the following Subtopics-
Head and Neck, Endocrine, Gastrointestinal, Urology, Spleen, Cardiovascular and Respiratory, Back and abdominal wall, reproduction, Upper Limb and Lower Limb, Histology and some clinical aspects.

The E-Tutorial was created using the MVLS Syllabus at the University of Glasgow. Those who use the E-Tutorial can test their knowledge with quiz's throughout the e-tutorial and a larger standalone quiz.

Each individual Artery has a paragraph of information followed by its origin, its branches and what it supplies. There are also diagrams on each slide clearly showing the artery.

The E-Tutorial has been formatted o be used on multiple screens including a computer/laptop, tablet and mobile phone.

All the images and videos used have either been drawn by ourselves or permission has been granted to use them for this E-Tutorial.

Measurement Error Of Traditional Callipers Versus Digital Scanner Software To Analyse Orthodontic Study Models

Ms Michelle Chua
Dr David Cross, Mr Neil Nairn
Dental School

Traditional plaster orthodontic study models are used to record and measure the size and position of patient's teeth. Three dimensional scanners are now available that store this information digitally. The aim of this study was to use the digital scanner to teach the concepts of measurement error (both random and systematic) and highlight the importance of a well-designed error study and calibration exercise before commencing a research project that involves measurement. Measurements using digital callipers on plaster study models (gold standard) were compared to measurements of the same digitised study models with the 3Shape OrthoAnalyzer (3Shape Medical, A/S, Copenhagen, Denmark) by three independent examiners. Results were analysed using Bland-Altman plots and Student's t-tests. The results indicate that significant random and systematic errors exist with both types of measurement systems. Intra and inter examiner differences also exist. Conclusion: When conducting a research project that involves measurement, the existence of random error must be assumed. A period of calibration and well defined point definition can keep this to an acceptable level. Systematic error can be eliminated by careful measurement and recalibration of measurement system and operator(s) at regular intervals. To test the validity and reproducibility of a measurement system, multiple measurements of the same data are required. This task can be completed by a single examiner, but it is better if multiple examiners are used. This type of error study takes time and careful planning but can have significant effects on the outcome of a research project involving measurement.

Creation of Head Anatomy E-tutorial

Miss Sarah Musbahi
Loubna Kraria*, Abdullah Ali*
Undergraduate Medical School

As part of our 2nd year of MBChB Student Selected Component, we are developing an anatomy e-tutorial as an online learning resource to be used by other students in our university and other institutions. The e-tutorial is a program developed on Adobe Captivate with an easy to use interface and interactive format incorporating learning aids such as mnemonics, and interactive quizzes to challenge the user. There will be clinical relevancies and skills related to the underlying anatomy integrated throughout the e-tutorial in order to give real life application. The anatomy discussed in the tutorial is specific to the head including an overview of the anatomical areas of the head, bones, muscles, nerves, cranial nerves, blood supply, lymphatics and organs including the ear, eye, nose and tongue. We will be conducting a student evaluation of our tutorial to analyse ease of use and efficacy through surveys, which will be completed by the Visualisation in Science conference and results of our analysis will be presented.

*Joint author and joint presenting

Using Photogrammetry to Create an Anatomical Learning Aid

Miss Katrina Wesencraft
School of Life Sciences

Digital photogrammetry is a technique which enables 3D space to be modelled from 2D images by collecting geometric information from overlapping photographs. Though photogrammetry was initially developed to accurately measure distances between landmarks during surveying and mapping, in recent years its use has become more extensive e.g. in animation, conservation and medicine. The aim of this project was to develop a prototype interactive learning aid using photogrammetry and to investigate whether the models produced were effective in improving students' anatomical knowledge. The anatomy of the sympathetic nervous system, which controls the internal organs, was of particular interest as studies have shown that despite its clinical importance, the anatomy of the sympathetic chain is often poorly understood by students due to its complex spatial relationships. Photogrammetry was undertaken of 2 dissections of the sympathetic chain and the software Agisoft PhotoScan Pro was used to create accurate, 3-dimensional models of the specimens. Unity game engine was used to incorporate these models into a simple, self-directed learning package. The package was then trialed by students who were asked to complete an evaluation questionnaire. Positive feedback from students (n = 7) indicated that the photogrammetric models were effective in improving their anatomical knowledge with 71% of students strongly agreeing that using the package improved their understanding of the anatomy of the sympathetic chain. This project has resulted in the creation of a unique and effective teaching aid, as no other 3D models of the sympathetic nervous system existed prior to this development.

Use of Modern 3D Graphical Plots in Complex Evidence Syntheses of Healthcare Interventions

Professor Alex Sutton
Nicola Cooper, Neil Hawkins, Terry Quinn, Sarah Batson
Institute of Health and Wellbeing

While the use of graphics for presenting healthcare data have been used as far back as Florence Nightingale, approaches have not evolved at a rate commensurate with recent advances in technology. This is despite increases in the sophistication of statistical analyses undertaken. However, with their use comes both a challenge and responsibility to present the data and results in clear and accessible formats.

For example, network meta-analysis (NMA) has received wide uptake for simultaneously combining trial results for all treatments for a condition, enabling, "Which treatment is best?" to be answered. The multidimensional nature of this type of analysis means insightful visualisation of data and results are difficult.

Two novel interactive 3d plots for NMA, and associated free software, are discussed. The first plot *simultaneously* presents the network structure and the pooled effect sizes using the software R. The second (available online: http://3dnma.com/) facilitates the visualisation of covariate distributions and imbalances across evidence networks using an AngularJS environment and the Three.js JavaScript library. The plots could have several roles including: i) exploratory data analysis, informing future modelling; ii) better understanding the results; and iii) educating users about complex synthesis models in an intuitive way.

The plots will be applied to several NMA examples and insights the plots provide highlighted. Through examining simultaneous representations of multiple dimensions of information, relationships between them can be identified and understood. We believe the scope for using interactive 3d graphics in healthcare evaluation is considerable and advantages over traditional static 2d representations will be discussed.

Development of a Gastrointestinal E-Tutorial

Mr Joshua Howard-Taylor
Christopher McCloy, Saud Al-Fadhel
Undergraduate Medical School

There is a growing trend in medical education for the use of interactive digital teaching mediums, moving away from traditional teaching methods. Studies have shown that these new mediums have been effective in improving knowledge in medical students. Here we have created an anatomy e-tutorial as part of our second year student selected component 'Creation of Anatomy E-tutorials' focusing on gastrointestinal anatomy. The tutorial covers the main learning outcomes for gastrointestinal anatomy in the second year medicine course at the University of Glasgow. Using Adobe Captive 9 the tutorial was created over a period of 5 weeks. The tutorial included gross anatomy, histology, neurovasculature, imaging and pathology of all the main organs within the gastrointestinal system. Furthermore, a section for clinical examination was covered, as this has shown to be an area of weakness among students. Micrographs and illustrations were self-produced in order to simplify and highlight areas of relevance. Interactive quizzes were also incorporated into the tutorial to allow self-assessment. It is intended to analyse data from surveys and before and after tests to determine whether this e-tutorial has provided a benefit to the students' knowledge and enjoyment of the area. It is hoped that this tutorial is successful in the above, with the possibility of free distribution to a number of other educational institutes.

Blended Digital Learning – Future-Proof Platform for Molecular Pathology Training in Diagnosis and Research

Dr Tomoko Iwata
Clare Orange, Craig Hunter,
Gerhard May, Leah Marks, Maria Jackson, Edward Tobias, Karin Oien
School of Medicine

Molecular Pathology could be considered as a newly defined discipline that interrogates disease mechanisms with combined approaches – morphological, molecular and bioinformatics. The needs for pathologists, scientists and health professionals in Molecular Pathology are eminent in clinical services and research. With a vision of creating the next generation of leaders who would drive this transformation, we must develop efficient inter-disciplinary training programmes for under- and postgraduate students that provides robust and future-proof solutions to this changing needs. As a start, our new MSc in Molecular Pathology has been custom-designed using a blended online learning approach that uses the forefront of Digital Education platforms including Moodle2 and PathXL. The first course component delivered in September-December 2016 had student number twice as high as originally envisaged and the feedback was very positive. The interests from international students have been also higher than expected. In parallel, an MSc option course Molecular Pathology (MED5410) is currently running for the second time with enhanced Moodle2 with a PathXL case study, enabling a strong student engagement and positive feedback. To further the substantial impact stemmed from the Molecular Pathology Node in Glasgow, we propose the provision of these courses, as well as the undergraduate medicine (BScMedSci), to national/EU and international students as a blended digital and online distance learning Molecular Pathology courses, using enhanced Moodle2 with PathXL digital pathology case studies.

Construction of Animations for Teaching and Learning

Dr Craig Daly
Janette Bulloch & Dorothy Aidulis
School of Life Sciences

Online material is now a crucial component of most (if not all) Higher Education (HE) courses. One type of content is video-style 3D animations. These can range from very simple to extremely complex and professional looking. Medical Imaging companies produce bespoke animations for media outlets and pharmaceutical companies. However, these can be hugely expensive (but beautiful to watch). In most cases they are an artist's impression and can contain no accurate anatomical or molecular detail.

The emergence of Autodesk University (au.autodesk.com) and the availability of free educational licences for their most expensive animation tools has opened up new avenues for content creation with HE. We have recently exploited this and developed a data flow; 'From Microscope to Maya' (Daly et al., 2014) which enables the combination of 3D Confocal Microscopy data with 3D protein structures within a sophisticated animation environment (Maya or 3D Studio Max).

The presentation will introduce some of the Autodesk products and will outline a data flow resulting in the creation of 3D animations for teaching, learning and public engagement. The presentation will also touch on the importance of 'instructional design', 'cognitive loading' and 'situational interest' as elements of the design process.

Cognitive Loading of Animations for Teaching and Learning

Dr Dorothy Aidulis
Janette Bulloch and Craig Daly
School of Life Sciences

The inevitable increase in online and e-Learning raises important questions about the design of appropriate materials for teaching and learning. Surprisingly, there have been very few studies on the instructional design of animations for Life Science teaching. Students often search YouTube for animations of Life Science related topics. However, most of these do not take account of multimedia theories of learning or theories of cognitive loading. We have previously developed a method of producing anatomically accurate 3D animations using data from Laser Scanning Confocal Microscopy (Daly et al 2014). In addition, we studied their usefulness as learning aids and found that Extraneous Cognitive Load may have been too high in our animations (Daly et al., 2016).

Our most recent study has looked at user selected cognitive load. 41 Students (L3 Physiology & Pharmacology) were offered 5 different versions of the same 3D animation with varying levels of text, music & voiceover. Students were given 15 minutes to study the 4 minute video before being tested. 70% chose voiceover & text. 58% prefer a Read/Write learning style, but only 1 student (2%) chose an animation with text only. Although 58% reported a preference for music whilst studying, only 20% chose an animation containing background music, but interestingly, background music did not affect the test results. This suggests that music did not add a significant extraneous cognitive load.

The presentation will review the importance of multimedia theory, the importance of cognitive loading and the design of 3D animations for teaching Life Sciences

Routes to augmented reality visualisation within CMVLS

Mr Neil McDonnell
Humanities

The immersive power of Virtual Reality (VR) technology lends itself easily to the world of games and entertainment, but the potential applications for visualisation in research, teaching, and clinical practice are vast. In a few years time however, VR will be overtaken by Augmented Reality (AR) which incorporates virtual entities into your ordinary environment, and here the applications for Medical Veterinary and Life Sciences become extraordinary. I will argue that waiting until AR technology is commonplace is a mistake, however, and that work can begin today on making the CMVLS at Glasgow a leader in this new avenue of visualisation.

Drawing on experience from my time in industry developing VR and AR solutions, and from my role establishing the VR Lab within the Centre for the Study of Perceptual Experience in Glasgow, I will sketch some of the potential applications of each of VR and AR and propose a practical route for researchers, teachers, and clinicians to realise that potential in advance of the availability of widespread AR.

The aim is to prompt thought and discussion about what uses AR could be put to in the future, and to prompt the first steps required to make that future our reality.

Digital mobile technology supporting student learning

Dr Nicola Veitch
Dr Pamela Scott
School of Life Sciences

Digital media technology has been used to create a mobile app to support students studying molecular courses, in order to enhance understanding of molecular biology practical skills. The Molecular Methods app is available to download and is now being accessed globally. The app houses bespoke online resources, including explanations of many commonly used techniques such as PCR, cloning and DNA sequencing, illustrated with images and flow charts. Developed as a digital resource to support student learning, it contains University of Glasgow bespoke YouTube videos with linked revision quizzes, in order to enhance theoretical understanding of certain aspects of practical molecular biology.
Molecular biology theory and methods are now perceived fundamental and underpinning to all Life Sciences, however, students can often find molecular biology conceptually difficult. Distinct and tailored methods to engage all students are therefore paramount and a range of materials have been developed to accommodate a variety of student academic backgrounds. The app has been developed in collaboration with undergraduate students and graduate teaching assistants in order to ensure the material available is focused on areas that students find most challenging. Previous work showed that students engaged well with apps in this context at the University of Glasgow and now a feedback study is underway to examine if the Molecular Methods app enhances student learning at external institutions.