The University of Edinburgh
Principal's Teaching Award Scheme

Project Final Report

Investigating Innovative Environmental Analysis Teaching Methods for Undergraduates

Project Team:

Ola Uduku, Gillian Treacy, Lisa Moffitt, and John Brennan, ESALA ECA

Introduction

This report outlines the outcome of a PTAS award funded project titled: "*Investigating how undergraduate learning in environmental design can be enriched through the introduction of new learning methods*". The project involved the development and introduction of basic environmental analysis software for use in undergraduate teaching at ESALA and the Design School, in ECA.

Methodology & analysis

In order to test the viability of our hypothesis, a number of academic experiences were reviewed. IES-VE the environmental analysis modelling programme, which we had customised for student use, Uduku N.(2012), was introduced to undergraduate teaching via tutorials, followed by 'hands on' interactive student use of the computer analysis programme.. This took place at ESALA and the School of Design, to year 2 Architecture and Interior Design years 1-4. students respectively. Gillian Treacy prepared, developed and led the tutorials and practical demonstrations of the programme in the first semester of the 2013/14 academic year.

Findings

Our findings noted two important advances in our students' learning using this new teaching tool. The first was that students were enthusiastic and able to complete the tasks set during the tutorials with very little extra help. This indicated that the tutorials and worksheets were prepared with clear goals, achievable for our student group or that the students were able to develop or build on existing computer skills to achieve the tasks relatively easily in a virtual environment.

There has been much discussion and research into the theory of "digital natives" (Prensky 2011) and "digital tribes". Watson (2013), introduces the concept of

individuality, culture and background to form the “digital tribe”. We found that our students predominantly in the age 19-23 age category, no matter their background, culture or previous life experience were “digitally aware” enough in year 2 of their course to complete the tasks in the virtual environment by attending tutorials and using the worksheets.

Very few student groups wanted further advice with the basic tasks set and fewer still requested and attended an extra tutorial, see Appendix A for figures. Most groups were carrying out the tasks confidently or wanted to accelerate their knowledge of the programme considering further applications.

When we considered introducing IES-VE software to the students we were aware, through discussions and tutorials with our students in previous sessions that undergraduate design students often found it difficult to describe their analysis of an environmental strategy in a confident way using appropriate technical terminology.

We found that after attending the tutorials and using the software students were notably more conversant in the terminology associated with the subject. The software requires students to input data that encourages an understanding of the terminology. The output from the analysis carried out summarises this information, again referring to the appropriate terminology.

Through repetitive exposure to the terminology in the field and using the virtual simulation software IES-VE, requiring specific data inputs, the students were able to practise using the terminology in a variety of contexts. It was evident in their coursework that some students had gained from experiencing environmental analysis in both forms; analogue and virtual digital environment testing (refer to Appendix C). Their design proposals and the academic discussions around their concepts confirmed some deeper learning. Research by Prosser and Trigwell (1999, p3-5) highlights connections made through learning that allow an understood concept to be applied in new contexts and varying ways, a deeper, non-“surface approach” and it is a display of this “cognitive flexibility”, (Feltovich and Spiro 1992) that we hoped to see in our findings.

This finding was confirmed by students in their feedback questionnaires and tutorial/review discussions as well as through their course work assignments. Our students were not simply using the terminology but were able to explain the application and the predicted results of this application in varying contexts. Students noted; “We used the programme to produce daylight factor results” (correct use of terminology), “The Stereographic Sunpath tool indicated the problems we would expect with overshadowing in December” (learning through analysing the results) and “The maximum daylight factor value was high so we expected problems with solar gain so we changed our design”, “the climate file indicated that we should take an alternative approach”, (learning through the iterative process within design).

Our students coped well with the new technology and method of learning on the whole, working in groups. Feedback was positive with some students choosing to use the programme for their final submissions. However, student engagement with the tool was less than we had expected as some students noted in the questionnaire that they had not trialled IES VE.

Some students were disappointed to have to use the software within UoE. It was not possible for them to carry out the analysis on their own laptops remotely. Students were also discouraged by the lack of workstations available during tutorial sessions and felt rushed to allow others a turn. Those working predominantly on Mac hardware had to convert their files to work on the PC based software.

We noted during tutorials that some groups of students, we assume those with less experience in 3D computer drawing struggled with the first stage; creating a model to use with the software. This result suggested to us that some students were either very daunted by the software and 3D computer drawing or they simply didn't have time to engage with it as it was not a graded task but presented as an alternative method to hand calculations. As yet we are unaware of any students using the software on their own in subsequent years (year 3 ESALA) but rather they continue to use it in parallel with other more traditional methods to create group project analysis and explorations.

In 2014-15 we are allowing specific tutorial time for the students to test out the software in the hope that these dedicated hours will encourage those that may not have engaged otherwise due to time constraints. This should also help with the problematic issue of 8 workstations for 120 students as students can have staggered tutorial times. We have also developed our tutorials further with the inclusion of an example building that they have first visited so that students can use it to test the programme without having to initially create their own 3D computer drawn design, refer to Appendix B for drawn 3D model example. We expect the familiarity of the example building will help students to understand the translation of the software more successfully. Output numbers and graphics will be displayed along with a real life comparison building (refer to Appendix B).

This session, we have also prepared the first tutorial many weeks in advance, including preparation sheets for the students uploaded to "Learn" 3 weeks prior to the tutorial date. Refer to Appendix B for excerpts from these tutorial sheets. Initial results are encouraging with 95% attendance at tutorials and some groups already starting their own building analysis for their assignments by week 6 which we were unaware of last academic session 2013-14.

We were encouraged by the response from students within the School of Design in 2013-14. Students studying Interior Design were asked to attend a tutorial and then try the programme for themselves in their own time. These students engaged well with the software and requested that it be included within their course next academic session. It was noted from small group directed discussions with the students that the software made technical language and calculations more accessible.

It was clear from student feedback and observing the reaction of the students during the trial sessions that this software appealed to students who often had less exposure to this type of learning and technical analysis and had not been previously taught hand calculations within this subject area. The idea of "instantaneous" results was met with enthusiastically in the student group. The analysis results in IES-VE could be achieved with the importing of 3D models in Sketchup™ that they, unlike

the under graduate architecture students, were generally very skilled and experienced at producing.

However, it was difficult to encourage deeper learning (Prosser & Trigwell 1999) as these students, with less background knowledge of the subject than the architecture students had no other methods of checking their results and still found it challenging to interpret the results. Their questioning was continuous and the worksheets needed further information to explain each step. With the little time they had to trial the software they were unable to fully analyse their results and their consequence, implications or further application.

This issue was noted within student feedback and has been addressed in the academic session 2014-15 within Interior Design by aiming to programme in tutorials during weekly lighting skillshops/workshops in semester 2. This decision will hopefully allow students time to analyse the results with the intention of creating further time to test iterations of their model building. As with the architecture students, we plan to use an example building for their first trials, a building that is familiar and one that they have visited, to allow a direct comparison between the virtual results and the real built space.

Our findings were disseminated to colleagues within the school informally and in a more formal situation at an HEA conference held in ESALA University of Edinburgh in May 2014.(https://sites.eca.ed.ac.uk/edenap/files/2014/04/OU_Higher-Education-Academy-Conference-Proposal1.pdf). We had a number of delegates from U0E and other Universities and SMEs who could see further applications of these tools within their teaching methodology and context. UoE academic staff were encouraged to propose further ideas and suggestions for the integration of 3D modelling and virtual environment into their teaching and suggestions were recorded. Practicing professionals attending the conference and visiting the webpage endorsed the idea of these tools suiting professional development courses and enhancing current professional knowledge in the field.

Outputs

The IES-VE virtual environment software has now been embedded within the course and the tutorials revised through ongoing student feedback for 2014-15 academic year. For the current session, we have further improved and embedded the programme within the teaching programmes for both T&E2A and Interior Design. The findings of this report focused heavily on student opinions on the value and viability of the virtual environment software in the past 2013/14 semester. We aim to record the experience of the tutors involved in the teaching of this tool to highlight any anomalies between student and teacher perceptions of digital learning in environmental design.

As part of our proposal, we hoped to continue with our students using digital tools in their learning by developing some apps to allow further building analysis if student feedback directed us towards this. Gillian Treacy presented our project, discussing the challenges and the development of the app at the PLDC Conference in October 2013 in Copenhagen, educators and post-graduate researchers' pre-convention meeting.

On the basis of our student feedback and reflective analysis of the environmental design teaching tool and methodology we have now developed an interactive teaching tool as an app for both Ios and android mobile phone platforms. This tool considers further the relationship of active learning, aligning teaching directly to a current technology accessible to all our students. We are considering suitable technologies in digital learning and reviewing the current research of Watson (2013) and Autry and Berge (2011), in relation to using digital tools in a learning context, not simply for the purpose of social media but as an active learning device. By trialling the software and mobile apps we are working with groups of students who have grown up with digital technologies. We are interested to learn of their expectation to use these technologies in their education or otherwise.

It is expected that our subsequent findings relating to both the use of IES-VE software and Edenap during the academic 2014-15 sessions will be presented at the PLDC educators meeting in October 2015 in Rome.

Linked research related outputs and activities

The main research activities related to this project have been the development of the environmental analysis mobile phone app; EdenApp. (https://sites.eca.ed.ac.uk/edenap). Currently EdenApp lighting is being used by students for coursework in addition to their use of the virtual environment software. So far feedback from last semester's analysis has been positive in using the android version app as a teaching tool. As of Setember 2014, we now have an ios version of the app, which is currently being tested by students. As mentioned in the report we also had a successful HEA-funded workshop which explored the use of digital tools in tertiary education (https://sites.eca.ed.ac.uk/edenap/files/2014/04/OU_Higher-Education-Academy-Conference-Proposal1.pdf)

Future proposals

Our long-term research plan is to achieve the EdenApp vision to develop a suite of environmental analysis apps. Because of its success, we aim to continue with the use of the virtual environment software tool within our teaching but each year this requires a budget allocation to renew licences. With the "apps" that we have created we have a tool that can be downloaded for free by students without the challenge of budget constraints. Currently there are no specifically focused environmental analysis digital teaching tools available as 'apps', and the current downloadable apps that exist are not designed for, or integrated into environmental analysis teaching, which is the ultimate ambition of the EdenApp suite of apps. We therefore hope to work with the information systems Learning Team and also ERI to explore the possibility of creating a marketable environmental teaching App that would be useable in Architecture and Design schools and also for CPD courses, for professions such as architecture, interior design, civil engineering and quantity surveying, in environmental analysis.

We are also considering a desktop interface space for EdenApp, which might integrate a further developed IES-VE tool for modelling analysis as part of the EdenApp teaching suite of digital tools and software.

Acknowledgements
We are grateful to T&E2A and Interior design students and staff for willingly participating in the reviewing of these digital tools. We are also indebted to our web development team; Cosmin Dumitrache and Emilian Radoi, who helped us code the apps, and to Ya Roderick and Ruth Kerrigan, who initially worked with us to develop the IES education model.

Bibliography

A.J. AUTRY, Z. BERGE., (2011) *Digital natives and digital immigrants: getting to know each other". Industrial and Commercial Training*, Vol. 43 Issue: 7 pp. 460 – 466.

M. PRENSKY., (2001) *Digital natives, digital immigrants: do they really think differently? On the Horizon*, 9 (6), pp. 1-6.

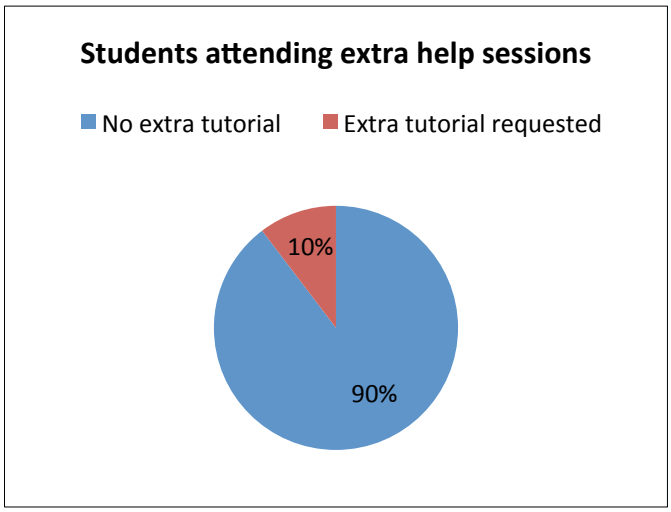
PROSSER, M., & TRIGWELL, K. (1999) *Understanding Learning and Teaching – The Experience of Higher Education,* Buckingham: SHRE.

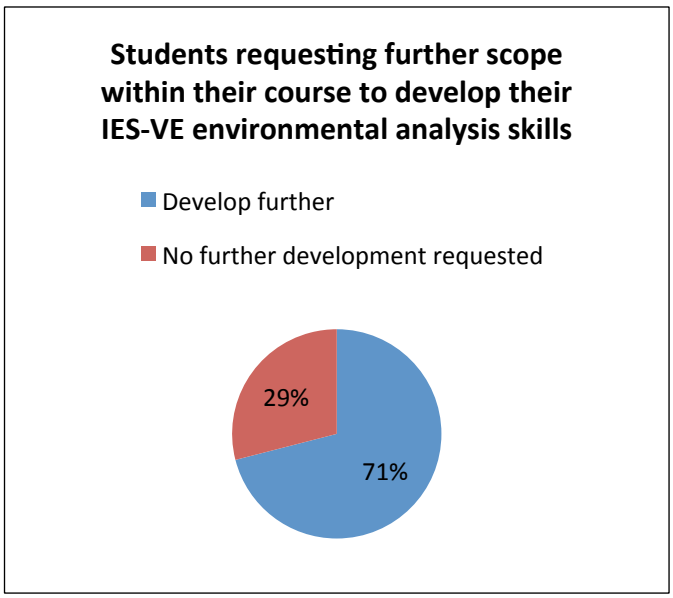
SPIRO, R.J., FELTOVICH, P.J., JACOBSON, M.J., COULSON, R.L., (1992) *Cognitive Flexibility, Constructivism, and hypertext: Random Access Instruction for Advanced Knowledge Acquisition in Ill-Structured Domains*, New Jersey:Lawrence Erlbaum Associates, Inc.

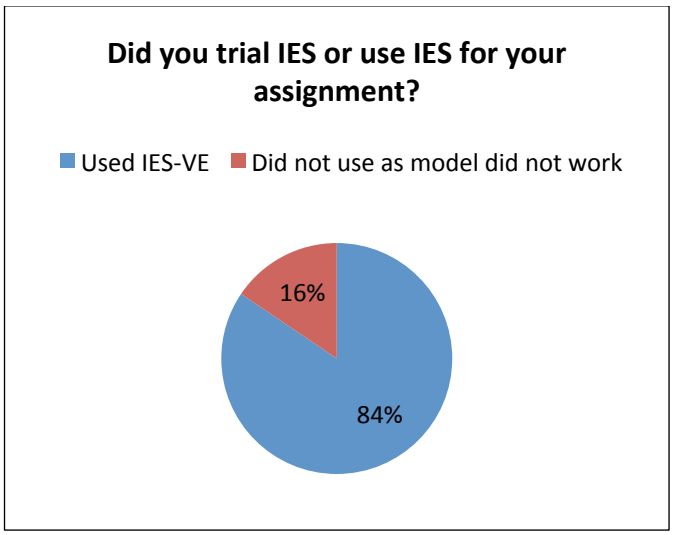
UDUKU N., (2012), *IES Education Project, CIC Educational Consultancy Report*, Glasgow CIC.

WATSON, I. R., (2013) *Digital Natives or Digital Tribes?, Universal Journal of Educational Research* 1(2): 104-112.

Appendix A


Students attending extra help sessions
No extra tutorial
Extra tutorial requested
10%
90%


Students requesting further scope within their course to develop their IES-VE environmental analysis skills
Develop further
No further development requested
29%
71%


Did you trial IES or use IES for your assignment?
Used IES-VE
Did not use as model did not work
16%
84%

Appendix B

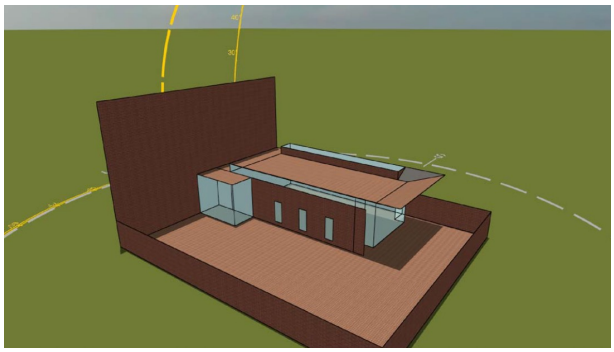
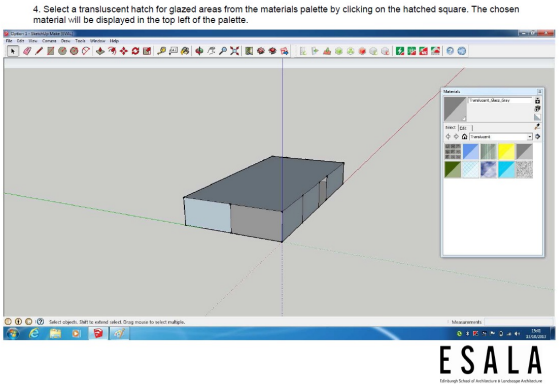
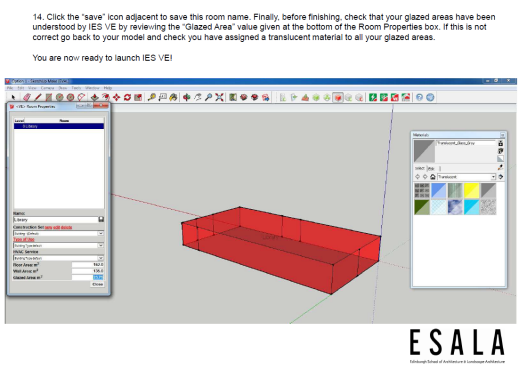
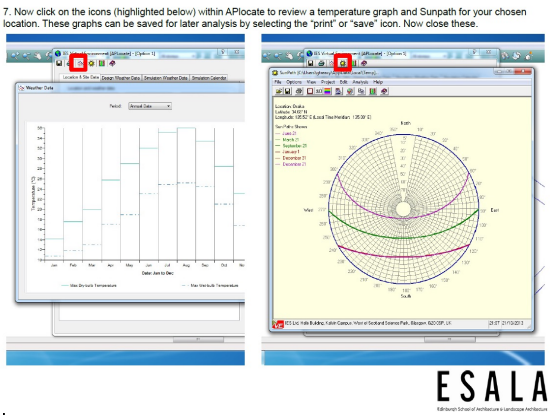
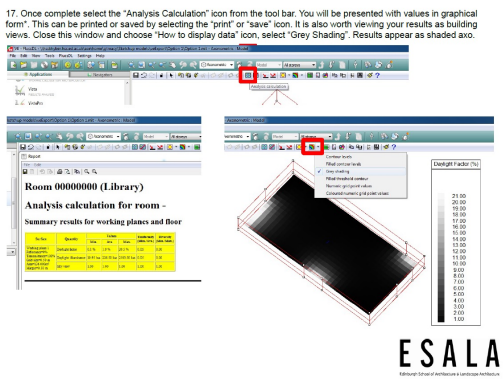


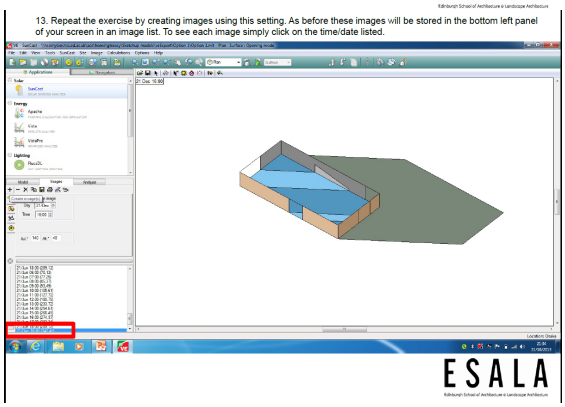
Image of St Albert's Chapel (left)
Image of St Albert's Chapel in IES VE student tutorial Oct 2014. (right)





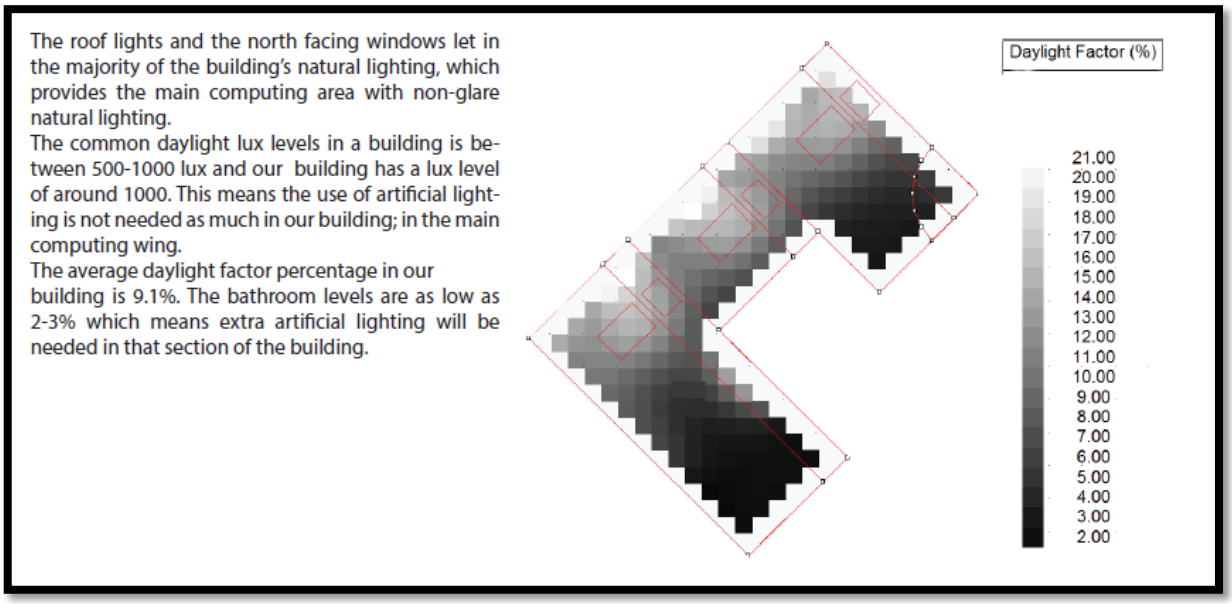






Snapshots from ESALA IES VE Tutorial step-by-step worksheets 2013-14

Appendix C



Example page from student project using IES VE including written analysis (ESALA Year 2 2013)