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Research Article

Evolution of E-learning Projects: A Creative Experience?

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Abstract

e-Learning Projects involve the construction by final year students of e-learning resources in project work. Students are supported in a blended training course in which they acquire appropriate skills and critically review eresources of their peers This paper describes innovations in course design that have lead to the evolution of eresources from simple web sites into interactive multimedia learning resources, the best of which are used in the undergraduate curriculum. The latest incarnation of the course includes creative thinking activities to facilitate more imaginative learning designs. This work aimed to compare project scores of e-learning students with those students doing traditional laboratory-based projects, evaluate the pedagogic design of the training course, and explore the impact on students of creative thinking activities. Course evaluation was positive, and students appreciated the collaborative approach to learning enabled by the use of online and face-to-face interactions, and there was no significant difference between e-learning and other project scores. A preliminary evaluation of student creativity demonstrated no statistically significant increase in the creativity of students pre- and post-course, but these results were limited by a small sample size, which may in part be due to time and work pressures on students at the end of their final year.

Keywords: e-learning (elearning); resources; creativity; inquiry; projects

Introduction

The student experience of bioscience degree programmes is frequently defined by the final year project. Over recent years there has been a proliferation of alternative types of project to the traditional laboratory scenario (Cowie, 2005; Luck, 2010). e-Learning Projects, ELPs, offer one such alternative, in which students across a wide range of bioscience disciplines, from anatomy to zoology, develop and evaluate e-learning resources (Wakeford & Miller, 2010). The challenge is to ensure that these projects offer an equivalent, albeit different, experience for students to their laboratory counterparts, and an opportunity for skills development in accordance with the Biosciences benchmark statements (QAA, 2011). Although the biosciences are fundamentally experimental subjects, the QAA benchmark statements acknowledge that "….computer sessions support learning in scientific approaches to discovery, practical experience, opportunities for acquisition of subject-specific and transferable skills, and reinforcement of the taught curriculum." Thus, e-learning may be viewed as an integral component of the bioscience programme. The University of Manchester is committed "to enriching teaching and learning through the provision of highly interactive online learning materials" (University of Manchester, 2009). e-Learning Projects support this commitment in two ways; first, in providing project students with an opportunity to develop both discipline-based and transferrable skills and acquire new competencies, and second, in generating and evaluating innovative online resources that stimulate higher order thinking skills in both the target group and the project students that develop them.

ELPs have evolved over the last six years from the production of relatively simple, largely text-based websites, to the development of interactive multimedia e-learning resources. Although this evolution was paralleled by the development of increasingly sophisticated software applications enabling easier web authoring, the principle driver for this evolution was a quest to improve the learning experience for both project students and their audiences. This, in turn, was driven by feedback from students and staff alike, including external examiners, who demanded a rigorous scientific approach to ELPs. The most recent adaptation of ELPs involved the piloting of creative thinking activities, and this paper describes the rationale for this strategy, along with a preliminary evaluation.

Typically, an ELP involves selection of a topic by the project student (informed by the project supervisor), followed by a critical review of the associated bioscience literature. One aspect of this topic is then teased out to form the basis of the eresource. The student selects a target group and may conduct a needs analysis and/or market research to establish the scope of their project. They develop an evaluation strategy, for which they require ethical approval, which is usually based on a hypothesis that relates to the potential effectiveness of the resource in promoting understanding of the topic by their target group. After attending a dedicated ELP training course comprising seminars and workshops, the project student will storyboard their ideas before constructing the individual components of the eresource. These are subject to a process of online peer review in preparation for evaluation of the completed resource by the target group.

Pedagogical design

The structure of the course was based on The Community of Enquiry Model by Garrison, Anderson and Archer (2002) Figure 1, and the Grammar of Inquiry Model by Justice *et al.* (2002; 2007).

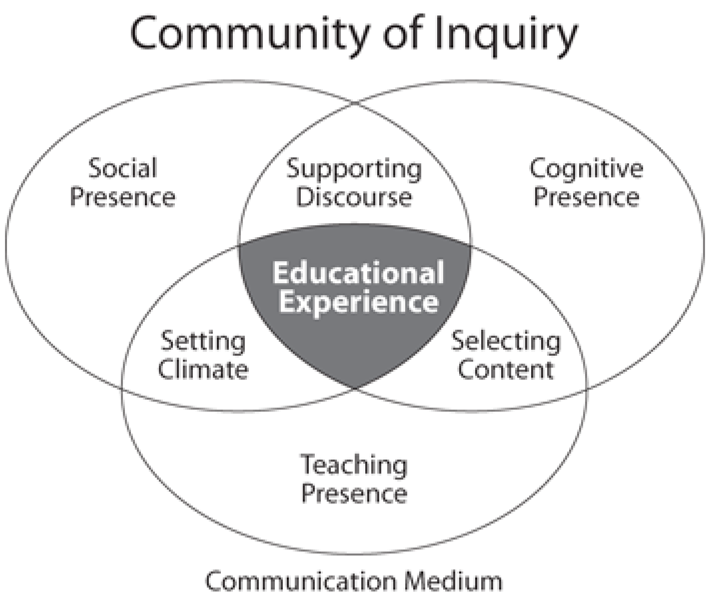


Figure 1 *Community of Inquiry Model (Garrison, Anderson and Archer 2000). Taken from Critical inquiry in a text-based environment: Computer conferencing in higher education. The Internet and Higher Education 2 87–105,* *http://communitiesofinquiry.com/model*

The former describes a framework to create a collaborative and constructivist online learning experience defined by interactions between the instructor, the student group and the academic content, (which Garrison *et al.* 2000 call the teaching, social and cognitive presence respectively), whilst Justice *et al.* provide a set of objectives to promote critical thinking in student-lead inquiry; a key outcome for project students. These were used as a checklist to ensure that the opportunities for student enquiry-based learning was maximised in ELPs. Accordingly, a system of online peer review of project materials was introduced (in VLE discussion groups) to encourage socialisation of students and provide peer support, and to facilitate group-based critical review of project materials. Discussions are moderated by the e-learning team (comprising the course instructor and learning technologists), and in addition, the project supervisor provides key academic expertise and support; these staff constitute the teaching presence. The cognitive presence was based on an active, constructivist approach in which students work both independently and in groups, and undertake activities associated with seminars to reinforce their learning and practise their skills (Table 1).

***Table 1** ELP seminars and associated tasks*

Seminar	Task
What are e-Learning Projects and what is e-learning (pedagogy)?	Online quiz on course format and pedagogy of (e) learning
Research and review the literature and online resources	Group discussion of selected journal articles; online review of resources
Target group, questionnaire design & ethics	Complete ethics form & design Needs Analysis for selected target group
Project planning & designs for learning	Project timeline/GANTT chart; outline learning design
What technology? Software toolkit, graphics, audio and video	Explore software applications (in relation to learning design)
Storyboard your project	1-2-1 discussion with e-learning team
Home sweet home	Build your Homepage
Literature review	Submission
Testing, testing: quizzes and assessment tools & evaluation	Design assessment & evaluation questions
Analyse your data	Qualitative and quantitative (statistical - SPSS) analysis of quiz scores and questionnaire data
Final report	Submission

Creative design

Despite innovations in course design, students continued to produce resources that were largely information- and text-based, so creative thinking activities were recently introduced in an effort to facilitate more imaginative learning designs. DeWulf and Baillie (1998) identified three characteristics associated with creativity; an ability to visualise ideas, effective use of memory in order to integrate new knowledge with prior knowledge, and an ability to think convergently and divergently. With these in mind, ELP students were tasked to evaluate a selection of online resources, before working face-to-face in groups to generate ideas for their *own* eresources using divergent thinking techniques such as brainstorming (thought showers) and brainwriting; random words and visual prompts to stimulate ideas by association; and development of analogies to help contextualise and visualise ideas; Table 2 (de Bono, 1970). Students subsequently evaluated their ideas and selected any promising ones to further develop by mind mapping and storyboarding (convergent-thinking); this 'delayed judgement' encourages a free flow and wide range of ideas, which can be 'incubated' subconsciously before their usefulness is assessed (de Bono, 1970; Nickerson, 1999). The SCAMPER technique shown in Table 3 was also used by some students to further modify and refine their ideas; this is an acronym representing a series of actions that can be used systematically to alter products (Michalko, 2006). An elab book was introduced to record these ideas, as well as for students to track their progress throughout their project work.

The elab book and peer review contributions were available to the project supervisor to help assess the Project Performance of their student, which counts for 15% of their total 30 credit project mark. Other components include 65% for the final project report and evaluation, and 20% for the eresource. In addition, the Literature Review based on the current bioscience research underpinning the project idea is worth 10 credits.

Table 2 *Creativity techniques; Students work in groups of four; one student presents their project to the group for ~3 minutes then records ideas for their resource generated by:*

Creativity technique	Student examples
Brainstorming 5 mins brainstorming of ideas.	*Some ideas for resource for nurses on the GI tract* Anatomy, histology, physiology Obesity-bariatric surgery Promote healthy eating or 'did you know' cool facts? Judging poo - Bristol scale for poo Clinical settings Cartoon-images compared to real images Answer a question before you can advance to the next stage of the GI
Brainwriting Students write an idea on a proforma divided into a grid of 4 x 4; they swop sheets and add another idea, and so on until the proforma is complete.	*Ideas for resource on obesity and type II diabetes* Option 1: Adipose tissue- visceral fat- white and brown fat Option 2: hormones from adipose- leptin, adiponectin, inflammatory tnf alpha, IL-6, circulating hormones ghrelin, cck,glp-1; genetics – stimulation & inhibition - drug therapies Option3: diseases associated - co-morbidities, obesity, T2DM, atherosclerosis; obesity global impact; NHS- promote healthy eating- benefits of exercising- depression and reward- cannaboid receptors
Random words A random word is selected (using an online generator) and the attributes of the word are listed. These are then used to stimulate ideas for the project.	Random word generate: THEATRE. Attributes: visual, uses sound to express ideas, can be interactive, uses characters, uses stories *Ideas for resource on cell signalling* Use characters (made up or from tv/film that is well known?) and assign them as components of the pathway. Have a different outcome: (for example do the two characters end up together/ in other words the pathway goes to completion, or is it inhibited by another molecule: a 'bad' character that gets in the way, holds someone back or 'degrades;/kills them). Good technique as it got us thinking 'outside the box'
Visual prompts Students choose a postcard from a selection and use the image to prompt ideas about their resource and/or educational experience. Ideas shared within the group, then the class.	"...a man hanging off a clock reminded me of time restrictions and the importance of being organised and the need to start planning for my resource now." "A picture of a train over a viaduct made me think of the different sections of my resource and how I could link them together in a linear sequence." "A photograph of a dog-sledding expedition across the snow made me think that studying can make you feel isolated and 'out in the cold' – shows the importance of engaging the target group in your resource."
Analogies Students try to generate analogies to represent aspects of the resources.	*Resource on adaptation* Could record a video of people demonstrating something such as a bottleneck, with people representing different genes from individuals in the population *Resource on circadian rhythms* Use a clock face as an analogy for the biological clock *Resource on determination of blood groups* Use images of teletubbies (with different shaped hats) to illustrate antigenic variation

Table 3 *SCAMPER creativity tool. SCAMPER is an acronym to help evaluate and modify existing resources. Students work alone and consider each aspect in relation to their resource. Example: Resource on alcohol dehydrogenase*

Substitute (what else could we do/use instead?)	Substitute one substrate for another to investigate enzyme specificity; substitute practical with e-resource; use different target group – physiologists?
Combine (how about a blend/combination/ assortment?)	Combine audio with video to explain how to calculate the initial rate; combine different enzymes and see how rate is affected
Alter/Add (can I use exisiting resources/ materials?)	Alter amount of enzyme or substrate and look at effect or *add* different substrates and measure the rate of reaction – virtual experiment
Magnify/modify (what could I change – meaning, mode, length, frequency?)	Zoom in on enzyme 3D structure to explore molecular structure at active site
Put to other uses (can this be re- purposed, change the context?)	Use resource for assessment, or revision, or pre-lab prep.
Eliminate - “less is more” (what can I leave out, condense, make lighter?)	Design a quiz of a virtual enzyme assay leaving out essential ingredients – student has to add what is needed
Rearrange or reverse (what if items are interchanged, transposed etc?)	Instead of monitoring absorbance, calculate expected absorbance from a given activity of enzyme; compare human alcohol dehydrogenase and yeast alcohol dehydrogenase – they act in opposite directions

Learning Design

A collection of e-learning resources that supports the undergraduate curriculum has been generated over recent years. Individual resources can be categorised according to the intended target group (course unit, practical class or tutorial activity, for example), the software used for web authoring (such as Wimba Create, OPUS, SBLi or Softchalk), or the learning design, which informs the choice of software (Wakeford, 2009). Learning designs range from relatively simple ‘tours’ around a topic where the user is able to freely navigate through the content, to more elaborate scenario-based designs that engage the user in more complex, higher-order learning. Here, the navigational route might depend on the choices made by the user at specific key decision points in the resource. Other designs feature interactive virtual experiments, and data analysis activities that incorporate problem-solving and self-tests with formative and/or summative feedback. These types of design lend themselves to a context-based problem-orientated approach to e-learning. A number of resources are now integral components of course materials. Moreover, three students have had their project work published in the literature over the last three years (Codd, 2011; Hider, 2010; Samani, 2009).

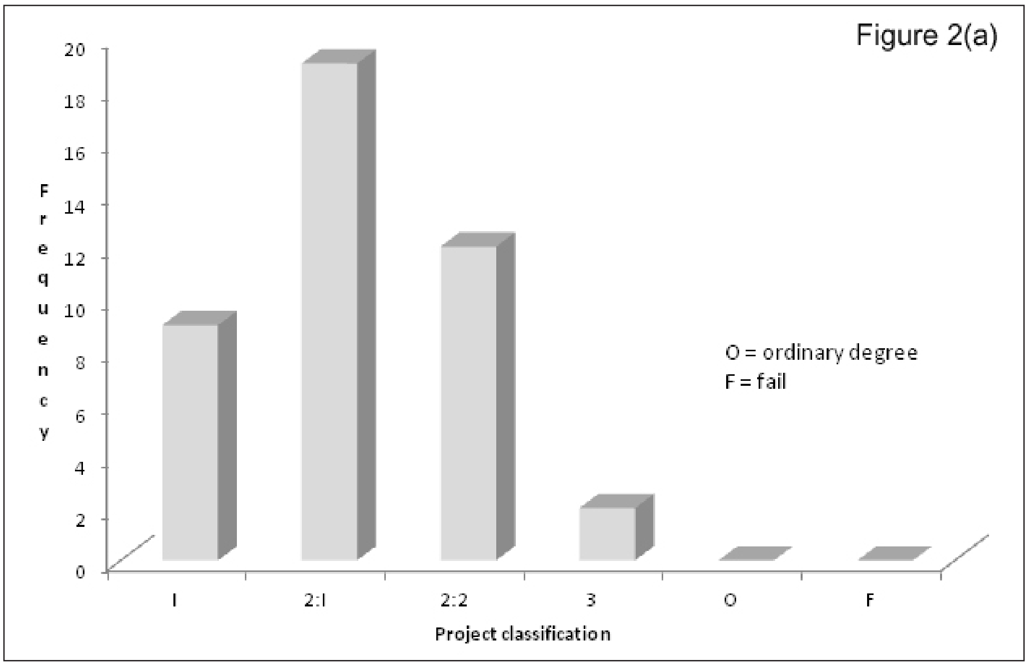
Evaluation strategy

The effectiveness of individual e-learning resources is evaluated by the project student using an appropriate target group, usually by pre- and post-intervention quizzes or by using control and test groups.

In order to address the question, “Are ELPs of the same standard as lab-based projects?” project scores were classified into first, second and third class marks, or ordinary degree and fail, and compared with marks for other projects that were similarly classified. The ELP course was evaluated each year by online questionnaire and in addition, in 2010-11, student creativity was measured before and after the ELP course by Torrance's Unusual Uses Task (Torrance, 1974), in which students record as many uses as they can for three common objects; in this case a brick, a blanket and a newspaper. The same objects were used for pre- and post-task, because the sessions were six months apart and it was felt that it was unlikely that students would be able to recall the uses cited in the initial task. Further, student perceptions of creativity were also evaluated pre- and post-course using an online questionnaire broadly based on work by Adams *et al.* (2010).

Results and Discussion

Project scores for 2010-11 demonstrated excellent overall quality control; the distribution of marks and degree classifications paralleled those of laboratory projects, Figure 2, and the mean project marks for ELPs of 69.1 (SD 12.0) was not significantly different from that of 68.9 (SD 8.9) for other projects.



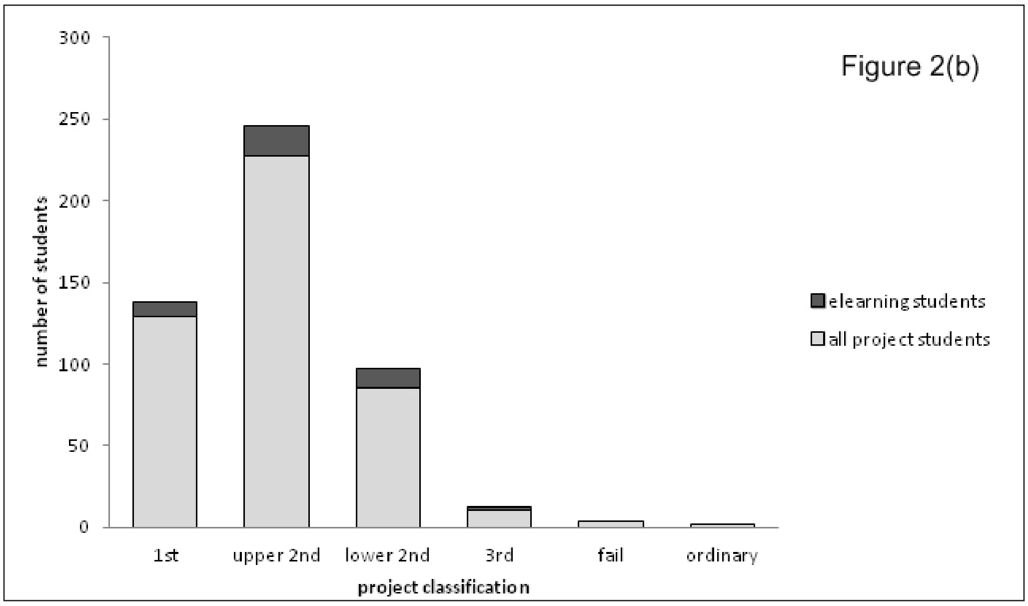


Figure 2 *(a) Classification of project marks for ELP students 2010-11; (b) Comparison of ELP classifications with those for other types of project, 2010-11*

Feedback on the ELP course over the last 3 years from both students and staff, including external examiners, was positive, with the course content being perceived as relevant and useful. Moreover, students generally appreciated the support they received from the course team. However, there are some issues for students around recruitment of appropriate target groups. Staff are encouraged to use ELP students to generate resources to support their teaching activities, in the same way that a lab-based project student would focus on their research activities. Unfortunately, this is not always practical, and recruitment of a target group remains a key problem solving issue for many project students.

Feedback from students has consistently supported the use of online groups for support and advice, and evidence from other studies demonstrates that this indeed improves engagement (Williams and Lahman, 2011). Students used the general discussion forum for social interaction, but participated in online groups for peer support, advice and help with trouble-shooting design and usability issues. In addition, text analysis using NVivo software demonstrated that a large proportion of students exhibited critical thinking in the online peer review process offering constructive criticism on both the content and functionality of e-learning resources.

Creativity

Torrance's Unusual Uses Task showed an increase in the mean total scores of students at the start of the ELP course from 3.20, SD 1.95, to that at the end, of 3.54, SD 2.0, although using a 2 sample t-test; this difference was not statistically significant at the 5% level, Table 4. This result was not particularly surprising, because creativity is notoriously difficult to measure, and it is possible that students underperformed in the post-intervention test because they were busy concentrating on revision and finalising their project work; this is indeed substantiated by the fall in the number of respondents from 25 to 16. In addition, by the start of their final year, many students might already have fairly well-developed creative thinking skills; this was supported by the responses in the questionnaire on student perceptions of creativity summarized in Table 5, in which around half of the students thought that they were generally creative, and only about 20% of students (22% pre- and 19% post-ELP) thought that they needed guidance on how to do it.

Table 4 *Measurement of creativity using Torrance's Unusual Uses Task pre- and post-ELP*

	Pre-survey n=25		Post-survey n=16		T statistic	P value
	Total uses	**Mean ± SD**	**Total uses**	**Mean ± SD**		
Brick	26	3.2 ± 1.8	33	2.9 ± 1.7	0.59	0.67
Blanket	33	3.0 ± 1.8	33	3.3 ± 1.8	-0.54	0.66
Newspaper	41	3.4 ± 2.2	43	4.4 ± 2.2	-1.45	0.19
Total uses	100	3.2 ± 1.9	109	3.5 ± 2.0	-0.94	0.26

Around half of students thought that creativity is very important or quite important in the biosciences, and this was the same both pre- and post-ELP. Again, over half of the students thought that they have the potential to be *very* creative, but just needed time and space to do it, and one student commented that creativity is often not rewarded in the biosciences, due to inflexible tasks/mark schemes. Since innovation and originality are important discriminators between students, as well as desirable attributes for employers (Sternberg, 2007), we as educators could perhaps make the recognition and reward for these attributes more explicit in our assessment criteria where appropriate.

Table 5 Survey of student perceptions of creativity

	% Responses pre-ELP (n=39)	% Responses post-ELP (n=10)
What do you understand by creativity?		
being artistic	64	41
thinking in different ways about things	94	95
able to express yourself in different ways	83	58
being open-minded	70	67
able to generate new ideas	65	51
problem-solving ability	65	42
What makes someone creative?		
They have solved a problem in a way that is different to how others have done it	38	32
They have thought in ways that are different to how they usually think	26	24
They have created something no-one else has	18	29
Can creativity be taught?	62	71
Can creativity be learned?	92	100

Interestingly, before beginning their projects, significantly more students (64%) believed that creativity is being artistic, to after (41%), suggesting that their notion of creativity has broadened beyond the purely aesthetic. Unfortunately, this was not reflected in their other perceptions; fewer students for example believed that creativity involved the generation of new ideas *after* they had completed their projects (51%) than before (65%). This anomaly may again be attributable to the small sample size, but warrants further investigation and a more comprehensive analysis will be implemented in the forthcoming academic year. In addition, different objects will be used for the pre- and post-Unusual Uses task to encourage students to cite fresh ideas, in an effort to obtain a more accurate measure of their divergent thinking capacity. There is much debate over what constitutes creativity, and indeed, on how it can be measured. For the purpose of this work, a broad definition by Vernon (1989) was adopted, “Creativity denotes a person’s capacity to produce new or original ideas, insights, inventions, or artistic products, which are accepted by experts as being of scientific, aesthetic, social or technical value”, and the Unusual Uses Task seemed appropriate to measure the volume of potentially useful ideas generated by students. Anecdotal evidence suggests that the quality of eresources has improved since the introduction of pedagogic innovations, and this work is based on the premise that although some students inevitably appear more creative than others, creativity can be nurtured and learned by practice using some of the techniques implemented here; encouragingly, 100% of students post-ELP agreed with this premise.

In conclusion, ELPs have evolved in part due to a demand from students for alternatives to the traditional laboratory project, and in part, in response to the pressures of increasing student numbers and decreasing budgets. Large numbers of e-learning resources have been generated, some of which are of sufficient quality (the fittest!) to be used to supplement course materials for subsequent generations of students (and hence be passed on). Although the introduction of creative thinking activities has not produced a measurable improvement in the creativity of the project students, evaluation demonstrates that the social presence overall promotes engagement with the course, and the cognitive presence (course content and activities) is both challenging and relevant to the development of the eresources, and thus provides appropriate context for learning. This, in turn, is facilitated and supported by the course team, the teaching presence. So, the Community of Inquiry Model seems to be a good platform on which to host the course, although the online collaborative approach to learning was supplemented here by an additional face-to-face social presence.

Further evolution of ELPs is inevitable in response to a demand for wider public engagement and clearer communication of bioscience research. e-Learning Projects occupy a niche that links bioscience, technology and science communication, and as such, are ideally suited to exploit this challenge in the changing academic environment.

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Software and Creative Thinking Resources

NVivo: www.qsrinternational.com/products_nvivo.aspx

Opus Pro 6: www.digitalworkshop.com/Products/Pro.shtml

Softchalk: www.softchalk.com

Scenario-based learning interactive: www.sblinteractive.org

Wimba Create: http://www.wimba.com/products/wimba_create

Random words: www.randomwordgenerator.com/randomwordtutorial.html

Random pictures: www.brainstorming.co.uk/onlinetools/randompicture.html

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