# HOW NOT TO LOSE A STUDENT IN ONE SEMESTER
## E-PORTFOLIO AT THE LEARNING AND TEACHING PROCESS IN STATISTICS

NOVEGIL SOUTO, José Vicente
Department of Statistics and Operational Research - University of Vigo, Spain
vnovegil@uvigo.es    Fax: +34-986801929

DE SOUSA, Bruno C.
Department of Mathematics for the Science and Technology - University of Minho, Portugal
bruno@mct.uminho.pt    Fax: +351.253.510.401

*An e-Portfolio must give a complete vision of the process of Skills Development and a translation of the progress into Objective Marks. By getting the teacher and student involved in the construction of the e-Portfolio, we are composing a class diary created by both of them throughout the learning progress. Through a series of applied examples we will show how the e-Portfolio can be used as a Learning Object, as a formative/summative assessment tool, as a summative assessment tool, and as a long-term learning tool. The ease of adaptability of the e-Portfolio helps both teachers and students to create the environment that better suits their classes, thus improving self-esteem and their attitudes toward statistics.*

## INTRODUCTION

Generally speaking, professionals have been using portfolios for a longer time than teachers have in the teaching and learning process. Although in this learning context, portfolios have been used mainly for assessment purposes at different levels we deal with some other processes involved. Namely, how should we assess our students, how to construct our Instructional Design to get students to play an active role in the all process, and what can be learned through an e-Portfolio. These are some of the questions we confront when dealing with e-Portfolios.

What is a Learning Portfolio?

- It is a selection of tasks done by the student.
- The student relates, in a reflective way, his/her own progress and his/her achievements in the learning process.
- This selection of tasks is centered on decisions and reflections related to the contents and documents which are to be shown for the student's assessment.
- The student's reflections and decisions must be founded upon skills and assessment criteria which will guide the teacher's feedback in the pursuit of the goals to be achieved by the student.

An e-Portfolio must give us a vision of the process of Skills Development and a translation of the progress into Objective Marks. By getting the teacher and student involved in the construction of the e-Portfolio, we are composing a class diary created by both of them throughout the learning progress.

In the teaching and learning process, different types of e-Portfolios may be considered. Consider the three types of e-Portfolios: developmental, showcase, and assessment. Their use depends on the objectives that we have chosen for our class.

In Developmental Portfolios, the main purpose is to provide communication between faculty and students. It is a way of demonstrating development of student skills over a period of time. They are considered works-in-progress where self-assessment and reflection/feedback elements are included.

Showcase Portfolios are created when a program or part of a program have reached the end. Its primary purpose is to highlight the quality of student work by demonstrating exemplary work and student skills. They may be used as a means of communication between potential employers and students at the end of a degree program.

For Assessment Portfolios, the intention is to demonstrate student competence and skill for well-defined areas. These competences are defined by program standards and outcomes. They have a tutoring component because teacher's feedback is provided. As we shall see, these may be end-of-course or program assessments primarily for evaluating student performance during the course. In such cases, we can use longer assignments and project learning activities.

Most portfolios share aspects of the three types of portfolios. In fact, they are hybrids. Self-reflection and feedback are two key elements of an e-Portfolio. A student who has no opportunity to perform self-reflection on his/her own work will have a diminished opportunity to optimize his/her own learning. In addition, such reflection and decisions must be oriented by timely teacher feedback.

Organizational steps and assessment achievements have been the most developed parts of e-Portfolios. But the Instructional part has been neglected. This part lets us survey the process of learning until the qualification is given. From an instructional point of view the portfolio is an instrument to be included in an "assessment planning." Thus, it is considered as Authentic Assessment that lets the teacher take decisions in order to guide the process of teaching and learning (Jon Mueller 2007). When using the e-Portfolio, both teacher and student make decisions, allowing different applications from the e-Portfolio to be derived.

The student must follow four steps when constructing his/her e-Portfolio: select, design, reflect and publish (Open Source Portfolio OSP 2007). The teacher uses it to guide and adapt the Instructional Design for the students. The first two steps may be integrated in what we will call the Learning Path. Thus we have the Learning Cycle as follows in Fig. 1.
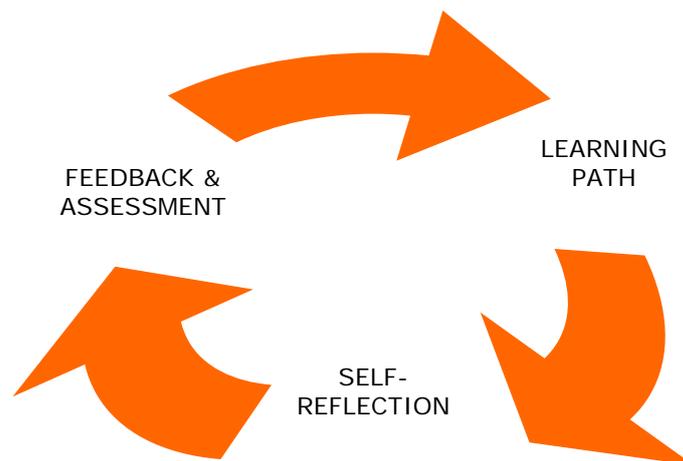


Figure 1: Learning Cycle

We can introduce this Learning Cycle into the teaching and learning process everywhere. It reminds us of the Deming Cycle for Quality Improvement and it can be used the same way: to improve the learning process.

The first step starts at the Learning Path where the student is learning through proposed activities in order to achieve the desired competences and skills. The student collects evidence about his/her advancement and puts it in a suitable format which constitutes the design part of the e-Portfolio.

Flexible tools are needed to make an e-Portfolio suitable for a very specific process. For that purpose, a Learning Management System (LMS) will allow us to organize the whole process from the construction point of view to its full potential use. An LMS lets us gather evidence with little effort, so the student does not need to spend too much time formatting the material. Different materials can be considered as evidence such as images, podcasts, audio, video, and many others that can be chosen by the student, instructor or both.

We can let the student design his/her own e-Portfolio but for its simplicity, we have considered an Excel Template (see Fig. 2) to be used in an LMS where the student very easily

shows his/her progress in the learning process through evidence delivered into the LMS. Excel will therefore organize the Design and Reflection issues in the Learning Progress while the LMS will be the teacher-student liaison in the Selection and Publication process.

| Activity 1 (A1) | Max Points | Student's Grade | Teacher's Grade | Strong Points | Weak Points | Improvement Proposal |
|---|---|---|---|---|---|---|
| Auto Assessment | 30 | 29 | | Calculations | Distributions | Understanding Discrete Models |
| Level 1 Question | 10 | | 10 | | Distinguish | |
| Level 2 Question | 10 | | 9 | Creativity | between question | Practice more |
| Level 3 Question | 10 | | 9 | | levels | |
| Practice | 15 | | 13 | Probabilities | Sampling methods | Managing time better |
| Complementary Work | 20 | | 17 | Problems Diversity | Decision Problems | Better understanding of concepts |
| Portfolio Reflexion | 40 | | 8 | 9 | 10 | 10 |
| Portfolio Evaluation | 5,56 | 79,4% | Point 1 | Point 2 | Point 3 | Point 4 |

Figure 2: e-Portfolio example table.

THE DIFFERENT WAYS TO USE AN E-PORTFOLIO THROUGHOUT THE LEARNING CYCLE

Due to the simplicity in the construction of the e-Portfolio, different aims are possible in order to guide the learning process. In this work, we will show how the e-Portfolio can be used:

(1)     As a Learning Object – to be used in class as small activities that will make students reflect on the different aspects of the concepts involved. By using the e-Portfolio as a class diary it will make students aware of their learning process.

Consider, for example, the Central Limit Theorem (CLT) where we want students to understand that the sample mean of $n$ independent identically distributed random variables with finite variance will be approximately normally distributed with expected mean $\mu$ and variance $\sigma^2/n$. Through a set of commands given to students in an EXCEL spreadsheet, we ask them to simulate the resulting mean from throwing 1, 2, 5 and 30 die. Being aware of what the result should be in the case of one dice, the discrete uniform distribution in 6 points, and after simulating first 100 results and then 100 hundred more and finally 800 hundred more (a total of 1000 results), they very easily understand that the more results you simulate, the more the produced bar graph will get closer and closer to the discrete uniform distribution in 6 points (the sample distribution of the sample mean). To illustrate this example, consider Fig. 3 where we exemplified how the above procedure is implemented in an Excel spreadsheet.
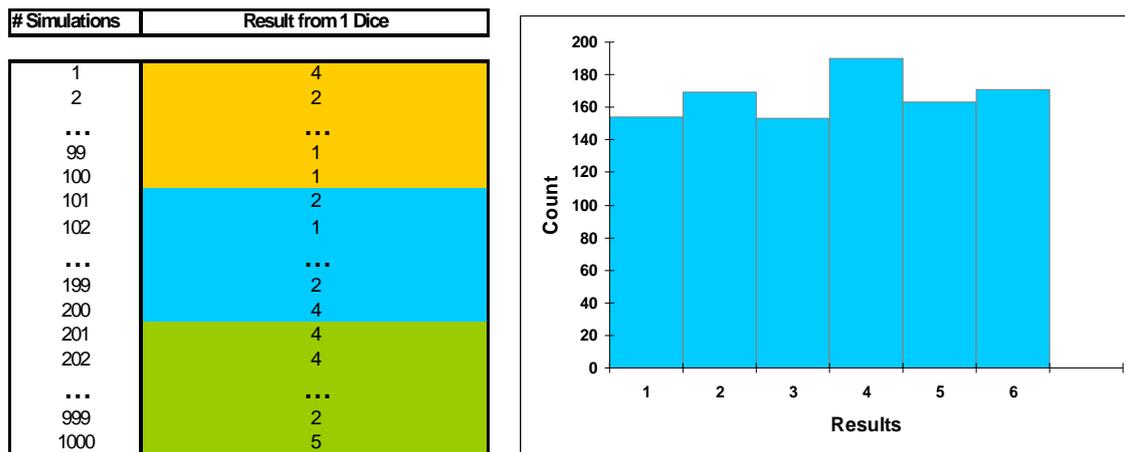


Figure 3: 1st step in the CLT Activity.

After this first step, the student is now ready to continue the activity and simulate 1000 averages from 2, 5 and 30 throws of the dice. The resulting graphs can be seen in Fig. 4.
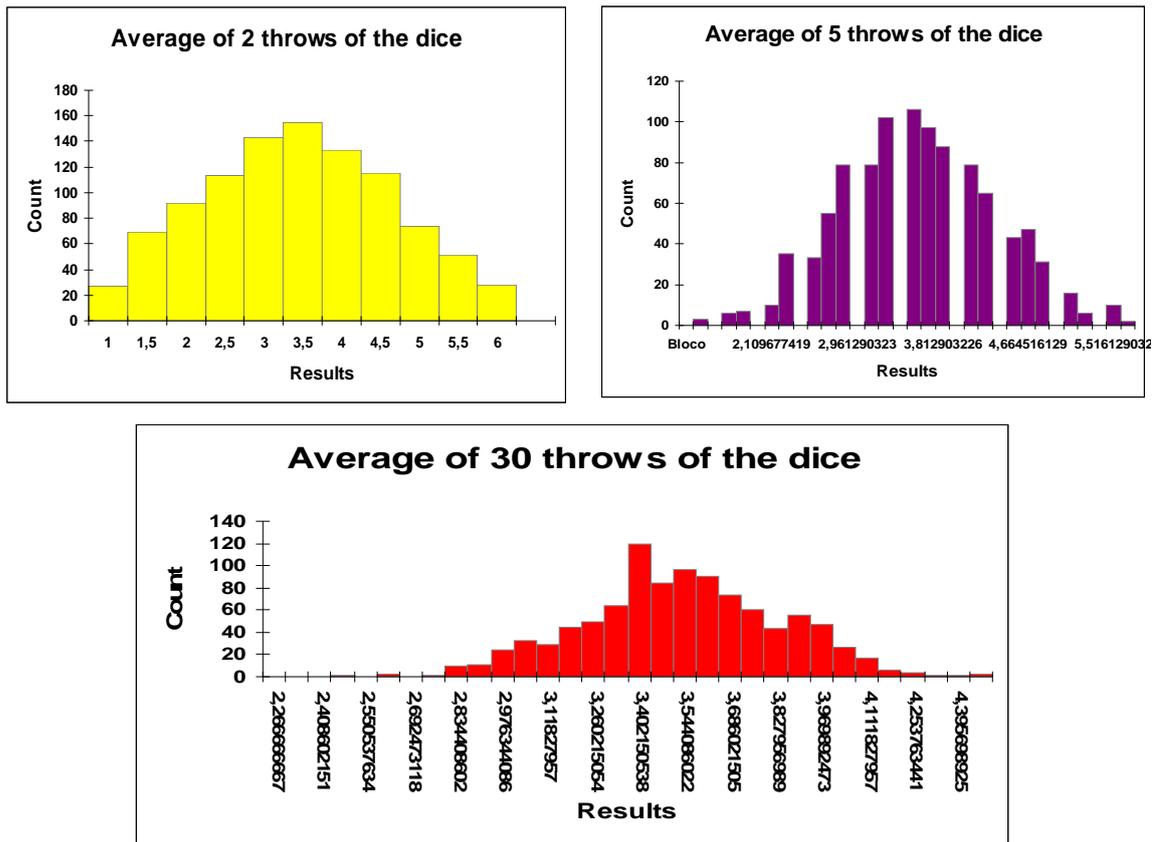
Figure 4: The CLT in action.


By doing this hands-on activity in EXCEL allows the students to replicate on their own the procedure as many times as they wish, thus enabling them to actually experiment with these concepts and realizing that, in fact, as n grows (n=1, 2, 5 and 30) the shape of the distribution of the sample mean converges to the normal distribution and that not only the mean of the 1000 simulations for n=30 is 3.49, very close to the true mean of 3.5, but also that the variance of 0.096 is very close to the true variance of 0.097 (2.917/30).

At the end of class, students will need to write a small paragraph on what he/she has understood about the CLT and fill in the e-Portfolio on his/her strong and weak points and some improvement proposals (Fig. 5). This will be sent to the teacher through the LMS (e.g. Blackboard) in the student's created private space.

| Activity 1 (A1) | Max Points | Student's Grade | Teacher's Grade | Strong Points | Weak Points | Improvement Proposal |
|---|---|---|---|---|---|---|
| Auto Assessment | | | | | | |
| Level 1 Question | | | | | | |
| Level 2 Question | | | | | | |
| Level 3 Question | | | | | | |
| Practice | 15 | | 13 | Constructing Graphs | Excel formulas | Reading more on CLT |
| Complementary Work | | | | | | |
| Portfolio Reflexion | | | | | | |
| Portfolio Evaluation | | | | | | |

Figure 5: The self-reflection part in the e-Portfolio.


(2)      As a formative/summative assessment tool – Longer assignments to be turned in after a week.  This middle point activity encourages the student to improve as the student takes into account a whole set of work.

The first line of the table in Fig. 6 can be reserved for the traditional "Problem Assignments" where the students need to turn them in after a week. After receiving the teacher feedback, the student needs to grade his/her own assignment and reflect on the strong/weak points and how he/she can improve (Fig. 6).

| Activity 1 (A1) | Max Points | Student's Grade | Teacher's Grade | Strong Points | Weak Points | Improvement Proposal |
|---|---|---|---|---|---|---|
| Auto Assessment | 30 | 29 | | Calculations | Distributions | Understanding Discrete Models |
| Level 1 Question | 10 | | 10 | | Distinguish between question levels | |
| Level 2 Question | 10 | | 9 | Creativity | | Practice more |
| Level 3 Question | 10 | | 9 | | | |
| Practice | | | | | | |
| Complementary Work | | | | | | |
| Portfolio Reflexion | | | | | | |
| Portfolio Evaluation | | | | | | |

Figure 6: The self-reflection part in the e-Portfolio.

At this time, students are challenged to propose 3 multiple choice questions in a Discussion Forum created in the LMS (Fig. 7.), one for each of the following levels according to Blooms' Taxonomy and will be scored by means of a predefined system of rubrics:

*Level 1:* Remembering concepts and understanding definitions in statistics
*Level 2:* Applying methods and analyzing results as a way to reason statistically
*Level 3:* Evaluating and creating solutions to real problems as a statistical way of thinking

The idea is to create a lively virtual environment where no one can repeat a question that was already proposed. Students not only have to read all the questions that were already proposed by their colleagues, but they will also quickly realize that the sooner they propose their own questions the easier this task is. The usual reflection period will follow after the deadline of this task and the results can be seen in Fig. 6. To engage students in this activity of the e-Portfolio, some of these questions can be used in midterm exams.



Figure 7: The Discussion Forum in Blackboard.

(3)     As a summative assessment tool – Project Learning Activities that can be performed and improved over the semester.  At the end of the course the e-Portfolio gives the student an overview of his/her skills at the conclusion of the process.  Project Learning Activities are taken into account in the whole learning process within specific subject matter.

As an example, we proposed a Sampling Project where the students need to collect the price of 5 different Supermarket products (including yogurt for all groups). The idea was to apply their knowledge of the different sampling methods given in class such that they were able to collect the data and perform an exploratory data analysis in order to answer some proposed questions. Students soon realize the complexity of the theory of sampling and became engaged in many fruitful discussions created through forums at the LMS.

(4)      As a long-term learning tool.  The student will be able to establish general skills regarding his/her work as a learning process over the long-term.  More sophisticated evidence can be included with podcasts and videocasts, allowing the audience to be aimed to a wide range of target-publics.

Podcasts are a great example on how to capture students' attention and make them focus in what is going on in class. A podcast is simply an audio or video file that can be view by anyone who has a computer or an iPod. They can be presented in many different ways such as audio or video recordings of lectures, software demonstrations, project presentations and many others. What we proposed in our classes is for students to create their own podcasts on a subject covered in class. The results were very promising and can be improved if implemented very early in the semester. Some examples can be viewed at http://estatmin.blogspot.com/

At the end of the course, student performance can be very easily seen through a series of graphs included in the e-Portfolio, of which we give an example in Fig. 8.  As we can see, Complementary Work helps the student to perform better in other activities.  Improvement is clear throughout the different lessons.
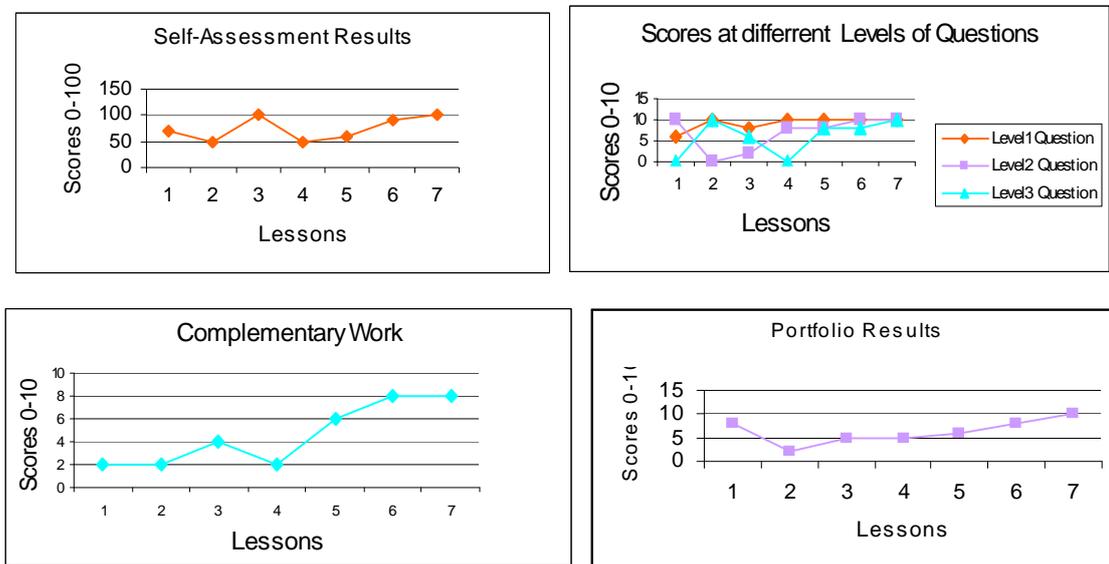
Figure 8: Student performance over the semester.

In all the different ways to use an e-Portfolio, timely teacher feedback is extremely important since it will guide the student in the activities that follow. The way that feedback is constructed takes into account a system of rubrics.  Assessment and tutoring are related to these rubrics and are adapted to four different uses in the e-Portfolio. We propose 4 different levels at which feedback can be given:

*Point 1:* Self-feedback as a result of reflection
*Point 2:* Peer feedback through communication tools across the Learning Path
*Point 3:* Teacher feedback across the Learning Cycle aided by the VLE (Virtual Learning Environment)
*Point 4:* Feedback from Faculty and Employers in those cases where e-Portfolios are shared with wider audiences other than the teacher and classmates

This gives the e-Portfolio an Authentic Assessment dimension. At the end, the teacher's final assessment will be registered in the student's e-Portfolio (yellow line in Fig. 9) and uploaded in the student's own private area at the LMS.

| Activity 6 (A6) | Max Points | Student's Grade | Teacher's Grade | Strong Points | Weak Points | Improvement Proposal |
|---|---|---|---|---|---|---|
| Auto Assessment | 30 | 29 | | Calculations | Distributions | Understanding Discrete Models |
| Level 1 Question | 10 | | 10 | | Distinguish between question levels | Practice more |
| Level 2 Question | 10 | | 9 | Creativity | | |
| Level 3 Question | 10 | | 9 | | | |
| Practice | 15 | | 15 | Probabilities | Sampling methods | Managing time better |
| Complementary Work | 20 | | 18 | Problems Diversity | Decision Problems | Better understanding of concepts |
| Portfolio Reflexion | 40 | | 8 | 9 | 10 | 10 |
| Portfolio Evaluation | 5,69 | 81,3% | Point 1 | Point 2 | Point 3 | Point 4 |

Figure 9: feedback in the e-Portfolio.

## FINAL REMARKS

As an assessment goal, a portfolio has two major goals: subject survey and demonstrating skills. These two aspects can be combined in different degrees in order to use an e-Portfolio. Statistics is therefore used as a tool for meta-learning. By making the student base his/her statistical reflection and thinking on qualitative and quantitative data, it will give evidence of his/her progress throughout the learning process.

We observed that e-Portfolios benefit learning most effectively when considered as part of an integrated teaching and learning approach, rather than as a discrete entity. Using a Virtual Environment, both students and teachers have the opportunity to draw out and present e-Portfolios at particular times and for particular purposes. As a Learning Object, the student is aided by the continuous feedback from the teacher and from his/her own continuous reflection on weaknesses and strengths.

There is then likely to be substantial impact on both learning processes and learning outcomes. There is continuous improvement on the process from the main actor: the student. Complementary work helps the students to improve their learning as a way to achieve and perform better statistical competence: in literacy, reasoning and thinking. The students may fit the learning process to their needs and the adaptability of the e-Portfolio also helps the teacher to create the environment that better suits his/her class.

The impact of e-Portfolios at the learning and teaching process is primary focused on: thinking about learning, better organized work and planning on improvement. Thus improving self-esteem and naturally improving their attitudes toward statistics.

More effort is needed about using e-Portfolios when a great amount of students are involved. Group e-Portfolios may respond to this challenge.

**KEYWORDS**: assessment, skills, e-Portfolio, formative, learning, learning object, podcast, research, summative, statistics, teaching.

## REFERENCES

Hartnell-Young, E and Cols (2007). *BECTA The impact of e-Portfolios on learning*, accessed on line on March 10, 2008 at http://partners.becta.org.uk/index.php?section=rh&catcode=_re_rp_02&rid=14007
Jon Mueller, Authentic Assessment Toolbox, accessed on line on December 9, 2007 at http://jonathan.mueller.faculty.noctrl.edu/toolbox/portfolios.htm
Open Source Portfolio, accessed on line on December 9, 2007 at http://osportfolio.org/
Regis Electronic Portfolio project, accessed on line on March 11, 2008 at http://academic.regis.edu/LAAP/eportfolio/basics_types.htm