

Chapter 7. Evaluation of Java resources for First Year programming

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1. Introduction

Within the Faculty of Information Technology, the computing undergraduate degrees require all students to undertake programming as part of their first year of study. Each degree has some variation on emphasis within the programming subjects (i.e. network computing, computer science, commercial computing), as well as a variety of teaching methods (i.e. lecture / tutorial instruction, distance education needs and problem-based learning environments).

The following reports on a large team-directed study that was in progress when it became a part of the CUTSD Action Inquiry project.

The aim of the original project, which received a Faculty Teaching Innovations Fund grant, was to develop a series of shared modular resources intended to supplement and support first year programming in Java. The grant was awarded to CERG (the faculty's Computing Education Research Group). It was intended that the lecturers teaching a course could use these resources as they saw fit, e.g., as demonstrations during a lecture, or as exercises for students to work through during tutorials, or as additional resources for them to use at home. The resources therefore were not tied to any particular course's sequence of topics, but were intended to be stand-alone.

The resources chosen to be developed were selected for the following reasons:

- Some topics were known to be difficult areas for students, based on their test and exam results and also on our feedback from students and tutors in other subjects.
- Resources developed for handling function calls for the C programming language had been implemented and used with

evaluations showing the resource was effective, thus it was expected that similar resources built using Java would also be effective. (Ellis, 1998)

- Support resources for bridging the knowledge gap and providing skill training had also been used before for DOS, and resources to demonstrate how to use BlueJ were expected to be valuable. (Ellis, 1993)
- When attempting to select appropriate Java textbooks for the first year subjects, the need for a comprehensive glossary of object-oriented terms became apparent. Few textbooks had clear definitions, if any, and there was some inconsistency in existing definitions and use of object-oriented terminology. Therefore, providing a common terminology base was important if students and staff were to be able to communicate effectively, learn from different lectures and texts, and share common resources.

Four resources were initially developed:

- A set of Screencam files that provide tutorial instruction on using the Java teaching environment BlueJ.
- A set of Toolbook demonstrations that illustrate the concept of parameter passing between methods in Java.
- A set of Toolbook exercises and demonstrations that cover the concept of factorization and code re-use in relation to use of methods in Java classes.
- A glossary of terms used in object-oriented programming.

2. Methodology

Our mentor indicated that the CUTSD project team (Phillips, Bain, McNaught, Rice, & Tripp, 2000) intended participants to use Action Inquiry in one of two ways:

- If practical, Action Inquiry was the preferred approach to evaluating computer-facilitated learning. However, it was acknowledged that some projects would not lend themselves to an action inquiry cycle, especially those evaluation projects that focus on evaluation of materials that are only used once in the semester e.g. a CD-ROM used in one week in the semester.
- Mentors were to use an Action Inquiry cycle to study and support the mentees with their evaluation project.

Action Inquiry as described in the CUTSD Evaluation Handbook, and the advice of our mentor regarding the cyclical nature of this approach, made the team more conscious of the Action Inquiry cycle. The team developed a two stage approach to the evaluation that could be equated with two cycles of action inquiry. However, this evaluation strategy was largely in place prior to the project's inclusion into the CUTSD Action Inquiry project and influenced the Java project only slightly (although the participants found the opportunity to listen to the views of outsiders useful).

3. Evaluation Plan

The evaluation of the Java resources was two-fold.

The first part of the evaluation was to determine whether the resources are potentially useful to students in traditional areas of weakness identified by those teaching the subjects.

Computing is a discipline that is still in its infancy when compared to many other disciplines. It is, therefore, a rapidly expanding and ever-changing environment. The members of this project have many years of experience in teaching programming, and considerable awareness of areas in programming that cause learning difficulties for students. However, the ever-changing nature of the programming languages, in terms of syntax, paradigm and programming environment, might have meant that previous techniques used to assist students in their learning no longer applied.

It was, therefore, necessary to do some preliminary formative evaluation of these resources to determine whether they are

functional, useable, attractive and accessible to students.

Students were asked to volunteer to be interviewed about their use of the resources. The interviewers were asked to observe the students using the resources and encourage them to verbalise their impressions of those resources. Questions were asked pertaining to navigation, ease of use and the purpose of the demonstration. Students were also asked to comment on their perception of the usefulness of the resource for their learning of Java.

The second part of the evaluation was to determine whether these resources have any influence on the learning processes and outcomes of the students, both in a formative and a summative way.

If one looks at the Bain Alexander Hedberg model for evaluation (Alexander & Hedberg, 1994; Bain, 1999), the evaluation of this project is very much at the design stage. Stage one of the evaluation represents the formative monitoring of the learning environment in terms of the functionality of the resources. Stage two focuses on the formative monitoring of learning process to determine whether the use of such resources is influencing the learning as intended. In the second stage of the evaluation, the team developed and conducted a survey of selected students who used the resources.

4. Results

Stage One of the Evaluation

The first stage was a preliminary formative evaluation to determine whether the resources were functional, useable, attractive and accessible to students. The results of this stage of the evaluation were primarily for the developers of the product to ensure the resources were useable and did indeed address the relevant learning issues.

This was carried out through interviews with a small number of students. Students currently doing the first programming subject in Java were invited to participate in reviewing the resources. As the students were volunteers, the process was one of self selection.

What the Data Revealed

Only eleven interviews were conducted. Five of the students were taking the subject run on the Peninsula campus. These students had been exposed to the Toolbook demonstrations as part of the lecture presentation, and some had also made use of the products in their own time. The six students from Caulfield had only made use of the resources in their own time. At the time of the interviews, the Toolbook exercises on Factorization and the Java Glossary were not available. Only the Toolbook demonstrations for parameter passing were reviewed. Some issues with these resources relating to execution and navigation issues were highlighted, and some general feedback indicated that the students thought that the resources were easy to follow, easy to comprehend, and the layout and content were satisfactory. The students also indicated that the resources were useful in explaining the creation of objects and the calling of methods and passing of parameters; however, due to the inexperience of the interviewers, only general impressions were gained as the interviewers did not pursue the various aspects of the resources in any depth.

Issues associated with stage one

- Because of staff workloads, third and fourth year students were employed to interview the first year students about their response to the resources. These interviewers were given a two hour training session which involved the following:
 - viewing the products they would be interviewing about
 - some general instructions regarding the ethics of interviewing
 - some instruction on approach to the interview (getting the student to demonstrate their use of the product and comment on its features, asking open-ended questions about its usefulness)
 - some instruction on how to ask open-ended type questions
 - what general areas to ask about (e.g. navigation, student's use of the product, etc.)

The interviews were taped, and each interviewer submitted a report on their observations from the interview. Due to the inexperience of the interviewers, most of their interviews were unsatisfactory. The questions asked about the products were, in most cases,

too general to provide more than an overall impression of the products and provided little useful detailed data. Interviewers were not given a specific set of questions, only a general approach to the interview, hence questions asked by different interviewers were not consistent across the interviews. Also information elicited about the products was generally obtained through the prompting of the interviewer. It became apparent that, apart from two students, most students had had little exposure to the resources and were only responding to the prompts of the interviewers. Also one taping was unintelligible and other interview was not taped.

- There was a shortage of students willing to be interviewed. Co-opting of students to volunteer for such evaluations seems to be a perennial and widespread problem. Only eleven students volunteered and of those, only nine interviews produced any usable data. This is out of a cohort of nearly 400 students. There was some discussion of payment for interviewees, however this was rejected on the basis of the limited funds. It is unlikely, therefore, that the eleven students interviewed were representative of the group.
- Some of the interviewers were unreliable. A number indicated interest and attended the training session, only to pull out due to work pressures. Others didn't follow up with the students to be interviewed. One interviewer failed to tape the interview and his written comments were sketchy. One interviewer did do a number of interviews, but then subsequently left the university, and we were unable to track down the tapes or written comments he had made of the interviews.
- A need for further examination of the resources in terms of their functionality and ease of use was indicated as the data from the interviews was lacking in depth, and hence these areas were incorporated into the second stage of evaluation.

Stage Two of the Evaluation

The second part of the evaluation was to determine whether these resources have any influence on the learning processes and outcomes of the students. Further examination of the resources in terms of functionality and ease of use was also incorporated here, due to the lack of depth of data from stage one.

This consisted of a broader survey of a larger number of students through two surveys.

Survey 1: determine computing background details

Survey 2: to determine the students' use of the resources in relation to the following:

- their impressions of the resources
- how they used them in terms of their learning (e.g. to learn new concepts, to revise existing concepts, to assist with assignments, to assist with exam study)
- whether they perceived them to be helpful in relation to the content of the subject being studied
- whether there were any inadequacies

Two surveys were given as the Caulfield students were completing the first survey in relation to other research being conducted. It was also felt that conducting only one survey would make that survey too long.

What the Data Revealed

Surveys were distributed to students enrolled in the first semester Java subjects at Caulfield and Peninsula, and to a group of students enrolled in a Java short course who were exposed to some of the resources.

While most students completed the first survey, only 32 students out of a total of 210 (10 in short course, 50 on Peninsula campus and 150 on the Caulfield campus) completed the second survey. This small completion rate of the second survey occurred for two reasons. First, the survey was presented late in the semester when many students were not attending tutorials. Second, the people involved in the project were no longer involved in the relevant subjects, hence encouragement to complete the survey was token at best.

Only three students actually used the BlueJ Screencams, eight students used the glossary, two students used the factorization resource and seven students used the code demonstrations.

Due to this small number of responses, only a frequency analysis was performed on the data.

The results are summarised as follows:

- **Resource one – BlueJ Screencams**

One student accessed the resource for < 1 hour (accessing only once), with the other two accessing it between 1 and 2 hours (accessing four or five times).

Students indicated they used the resource to learn some new Java, as revision and to help with assignment work. Interestingly none indicated they used the resource to learn how to use BlueJ, which was what the resources had been intended to support.

Only one student found the resource difficult to use, and all indicated a moderate level of confidence in using BlueJ with two of the three students indicating approximately 50% contribution of the resource to their confidence in using the product (BlueJ) it was intended to support.

- **Resource two – Glossary**

75% of students (6) used the glossary for less than two hours.

The use of the glossary was directed more to learning some new Java (5), assisting with understanding (6) or helping with assignment work (5) rather than study (3).

Students found the product easy to run and use. They also found the glossary had helped with their understanding of the various Java concepts, subject material and terminology, Java texts and references. They found it helped to a lesser extent with assignment and exercise specifications and code. This was as expected.

- **Resource three – Factorization resource**

Only two students who completed the surveys indicated they had used the resource, so it is difficult to draw any conclusions from the data. The students both indicated the resource was easy to use, install and navigate. Comments made indicated some misunderstanding of some navigation features of the resource.

- **Resource four – Parameter passing and method invocation demonstrations.**

For these resources, all of the students (7) who had used these resources indicated using the first two resources, yet only one student used the third resource. This might

be due to the first two resources being more general in nature, while the third showed a particular feature that may not have been covered in that particular subject.

The usage was 1 – 3 hours, with most students accessing the demonstrations two or three times.

Five of the seven students used the resource to learn some new area of Java and to assist with assignment work. All seven used it to try to improve understanding, with only three students using it for study purposes.

All students found the product easy to use and install, with only one student finding navigation difficult.

Students indicated moderate to high confidence in the concept areas.

The comments indicated a problem with stopping execution of the demonstration, something that was highlighted in the stage one interviews, and a request for the product to be platform independent.

• **General Comments**

There was a positive response (12 students wrote comments) to recommending the resources for use by others.

Students indicated that the resources should be more widely advertised and available in a platform independent way (e.g. on the Web).

Issues Associated with Stage Two

- Not enough students knew of the resources. A strategy needs to be employed to ensure students are aware of resources. It would also be best if the resources are incorporated into lectures and / or tutorials and influence the assessment for the subject, rather than just made available to students.
- For those that did use the resources, the results indicated that the resources were being used as expected (except for the BlueJ Screencams resource which was used more for understanding Java than to learn about the use of BlueJ).
- Students indicated a preference for a resource available on more than just the PC platform, preferably on the Web.
- These students found all resources easy to install, run and use, although comments

indicated a need to provide some help / explanation for certain features of some of the resources.

- The comments made by students provided the most useful feedback.

5. Discussion

Some of the issues arising from the project were as follows:

- The action inquiry cycle did not really match the nature of the project and possibly made it more difficult for the team to undertake the evaluation as they constantly attempted to adapt their existing evaluation plan into one aligned with Action Inquiry.
- Resources were still being developed during the evaluation process and not all were available for the various stages of evaluation.
- Interviewers were inexperienced and as a consequence the first stage evaluation did not produce the level of data we had hoped for.
- It was difficult to get students to volunteer to be part of the evaluation for stage one and only a small number of students completed the surveys in stage two.
- Lecturers responsible for the subjects were no longer those developing the resources. This made it difficult to ensure that the resources were used in the teaching. As the resources were not incorporated into the formal teaching environment, the use of the resources by students was very limited.
- The group members of the project were spread across three campuses, making meetings difficult. Video conferencing was used when possible, but this is not very satisfactory for working meetings.
- Time release for those on the project was not built in, and heavy workloads made completion of the resources and the preparation of evaluation materials very difficult.
- There was no formal budget for evaluation, hence it was not possible to employ trained evaluators to assist with the evaluation process.

6. Conclusions

Action Inquiry in the Context of the Java Resources Project

The team had only limited success in the use of Action Inquiry with the Java resources project for several reasons.

First, the Java resources project was well established prior to the team receiving the CUTSD funds for the evaluation and was not initially grounded in Action Inquiry (or Research) and so the development team adapted the project to the Action Inquiry methodology wherever and whenever possible and/or practical. The team found it useful to review the teaching and learning issues of the Java subject from which their interest in the three separate types of resources arose. However, the team's association with Action Inquiry was a weak one because the development of the resources was based on a retrospective review of the teaching and learning of programming, rather than on a review from which the team would plan particular changes to their teaching.

Second, adaptations to the evaluation project were made because of changes in the team, the lecturing staff of those subjects intended to use the resources, and some of the software the resources were intended to work with. As a consequence, the project evaluation process departed from action inquiry because the *planning* was not as "systematic", the *description* not as "complete" and the *review* or analysis not as "exhaustive" as is expected in an Action Inquiry. There were also times when directions taken and approaches adopted reflected external pressure that had little to do with promoting good teaching practice and investigating learning issues in order to promote good teaching practice. This was especially true when new priorities occurred during the analysis or review cycle of the process. Third, the cycles of the process require time, and often the analysis and review stages were rushed in order to be able to collect the next lot of data, with a fall back on surveys and statistics rather than qualitative approaches to the data collection. This then led to loss of information about the "why" and "how" of the evaluation, making it difficult to inform teaching practice in the future.

7. References

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