Comparison of On-Line and Blended Learning for Training in UML

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1 Introduction

e-Learning, while offering many advantages over traditional classroom-based courses, has not fulfilled its aim as the ultimate solution to the training problem. Many organizations are now examining different blends of learning, taking the best aspects of both classroom-based and on-line training, to provide more effective learning opportunities to employees.

Lifelong up-skilling is vital in the software engineering industry, where employees need the ability to adapt to new technologies and methods in order to remain competitive. The UML (Unified Modelling Language) is a relatively recently developed methodology used for developing object-oriented software. Because of this, many developers have had little or no formal training in UML. This has resulted in a low level of use in the software industry.

Having identified the need for effective training in UML, we designed a study to estimate the effects that a blended learning setting would have on learners and the training effectiveness.

2 Blended Learning

Blended learning is not a new concept, although the term was first used in 2001 (Sloman, 2003). Teachers have been blending methods in the classroom for years, choosing the type of activities that best meet their learning objectives. “Blended learning focuses on optimizing achievement of learning objectives by applying the ‘right’ learning technologies to match the ‘right’ personal learning style to transfer the ‘right’ skills to the ‘right’ person at the ‘right’ time” (Singh & Reed, 2001). It is obvious from this definition that blended learning aims to optimise several parameters at the same time. However, in this study, we focused on only one parameter which is frequently referred to as the most important for designing a blend: the combination of on-line and classroom-based learning in order to "maximise the benefits of both face-to-face and online methods" (Osguthorpe & Graham, 2003, p227).

3 Methodology

In order to estimate the effectiveness of different blends, a course was developed, Up2UML, designed to be delivered in a variety of different blends. The main target group for this course are software professionals working in small to medium enterprises who wish to learn and gain competence in UML.

Five units were chosen from the complete course to build a course on "introduction to UML". The first unit, Introduction to the Unified Process was chosen as it puts the UML into context and allows the learner to see how it can be used in conjunction with a proven methodology in practice. It was felt that the second unit, UML diagrams, was also important in order to give an overview of the UML and enable the learners to pursue additional topics at the end of the experiment if they wished. The Use Case Diagram, Activity Diagram and Class Diagram lessons were chosen as the additional three units as they are most commonly used by analysts in the business process.

The course was publicly announced and people were invited to enroll. In total 15 participants, 12 male, 3 female, agreed to participate in the course. None of the participants had any experience in UML, although some had heard of it. Therefore there was no need for a pre-test in the experiment. They were all working, or intending to work in the near future, in an environment where competence in UML would enhance their job performance.

Participants were then assigned to two different conditions: The first group was self paced and completed the course on-line whereas the second group attended a number of face-to-face sessions, in addition to having access to the on-line materials.

Effectiveness of the courses was measured in two ways: First, a summative assessment test comprising of 50 multiple choice items was developed to measure learning gained by both groups. Secondly, a feedback survey was also conducted at the end of the course. This survey consisted of 76 statements, with an additional four for the on-line group. For the most part, statements were given in pairs, with respondents asked to indicate their level of agreement with one negative and one positive statement per sub-topic. The survey was used to measure the reaction (Kirkpatrick, 2006; level 1 analysis) to both editions of the course i.e. how did the participants feel about the course, whereas the test evaluated the learning achieved by the participants (level 2 analysis).

4 Results

Due to a high drop-out rate, only seven participants completed the course. Both groups indicated that they were highly satisfied with the course, had learned as a result of the course and felt that it was relevant to the workplace.

Bersin (2004) identified a number of tracking elements for a blended learning course which are used here to structure the results of this study:

- Enrollments: how many learners have enrolled?
- Activity: are the learners actually using the available materials?

- Completion: how many learners completed the course? What does completing the course mean?
- Learning Score: how well do participants perform on the course?
- Certification: have learners earned a certificate?
- Satisfaction: how satisfied are the learners with the course?

For ease of reference, while maintaining confidentially, each participant is referred by via a two-letter code, the first letter referring to the relevant group; O for on-line and B for blended, and second to distinguish learners e.g. there are four members of the blended group – B-A, B-B, B-C and B-D, while there are three members of the on-line group – O-A, O-B and O-C.

4.1 Enrollments and Completion

Only six participants from the blended group showed up at the initial course start. The additional participant had to cancel at the last minute but still wished to continue the course. The on-line group were scheduled to start the course a day later, but by the end of the day, only one had logged in. However, two of these participants were out of the country and so were not expected to start the course on time. Contact was made via e-mail with all participants who had not started the course.

Only four participants attended the second face-to-face session, with apologies received from two others. Both of these had commitments at work and could not take the time away to attend the class. This is despite the fact that the class started at 6:30pm in the evening, after standard working hours. While telephone contact could not be made with the final participant and would not reply to e-mails, he continued to log on to the course.

By the end of the experiment, out of the seven learners in the blended group, all participated in the course to some extent, but only four learners, three male, one female completed the course, resulting in a 100% participation rate and a 57% completion rate. A learner was said to have completed the course once they turned up for the final session and completed the survey and end-of-course test.

By contrast, only four members of the on-line group, out of eight who signed up for the course, logged on during the two weeks of the experiment, resulting in a 50% participation rate. However out of these four learners, three completed the course, resulting in a completion rate of 37.5% of learners who signed up to the course or a 75% completion rate of learners who participated in the course.

Contact was established with two of the blended course drop-outs and the drop-out who had started the on-line course. All three expressed regret at not being able to complete the course, as they all were eager to gain proficiency in the UML and all cited heavy work commitments and lack of time as reasons for not completing the course.

4.2 Learning Score

In order to compare the two groups in terms of their learning score, a Mann-Whitney U test was used. Performance on the 50 question end of course multiple-choice test was taken as a measurement of the learning achieved. No significant difference between the groups was found ($U=4.0$; $p=.48$).

4.3 Activity

A lot of the criticism of e-learning only courses centred around the fact that they were boring or just classroom lectures or textbooks put on-line. By the same token, it is recommended to add various activities in order to enhance the course. In the survey, a number of statements specifically related to the additional resources provided were put to both groups in order to gauge their attitudes towards them. In addition, the actual levels of activity on both versions of the course were measured. Examining activity levels is important in terms of future blended course development as, if an on-line resource does not provide sufficient added value to the course, one has to question whether or not it should be present.

4.3.1 Survey responses

In terms of added resources in general, there was a clear distinction between the responses given by the two groups as shown in Figure 1. Participants' responses to statements 44 ("The resources provided, other than lessons, enhanced the learning experience") and 53 ("There was no need for additional resources outside the lessons") were scored and averaged. If the average score was 4 or more, the participants was deemed to find the resources helpful in terms of enhance learning on the course, whereas if the score was 2 or less, the resources were classified as not helpful. Remaining averages were exactly 3 which indicated that the respondent was unsure whether or not the added resources were helpful. All of the on-line only participants, found the on-line resources helpful, with 4 being the lowest score. By contrast, there was a greater spread of responses amongst the blended group. This could indicate that providing additional on-line resources is more important if the group are not going to get the opportunity to meet face to face.

The resources were then broken down into components and all participants were asked to indicate their attitudes towards the links provided, animations available within the lessons, additional exercise provided in the course environment and the project. The responses were analysed in a similar manner to the overall question about resources. Scores of between 2.5 and 3.5 inclusive were categorized as unsure overall as there was no strong indication whether or not the resource was helpful or not.

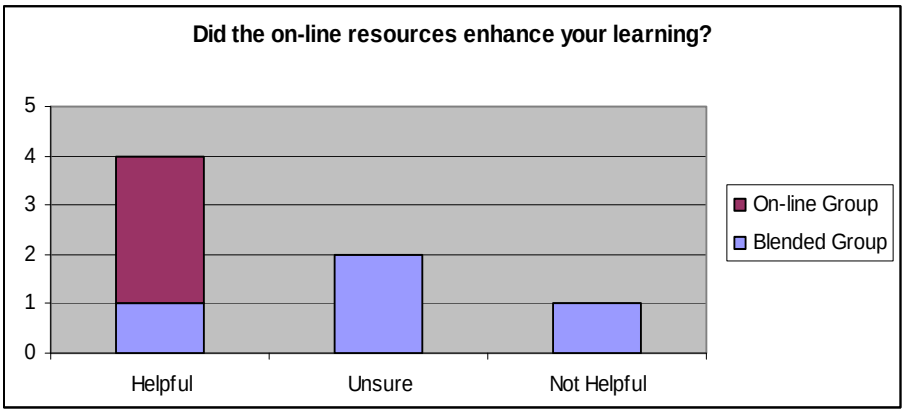

Fig. 1. Number of participants rating the on-line resources as helpful, unsure or not helpful, separated by groups.

All statements addressed the usefulness of the resource in terms of learning as opposed to whether or not it enhanced the enjoyment of the course. The responses overall were very positive, with the exercises provided considered to be the most useful of all resources provided (see Figure 2). The animations provided were considered least useful, but this could have been because only one of the animations, provided within the lessons, worked properly. All participants had commented independently on the lack of animations indicating that they would have enhanced the course.

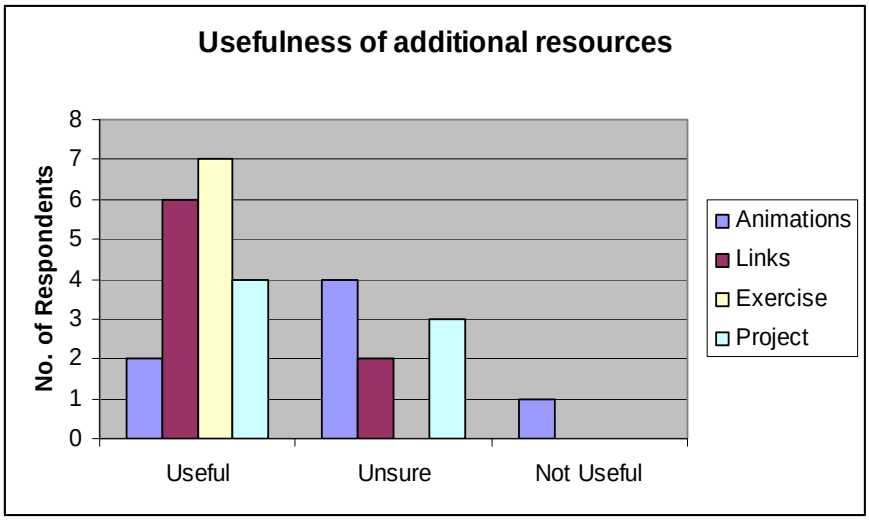

Fig. 2. Number of respondents rating the usefulness of different added resources

Responses for both groups were very similar with the exception of the statements relating to the project. The attitude toward the project elicited a more positive

response from the blended group and a less sure response from the on-line only group (see Table 1).

Table 1. Number of respondents' attitudes towards usefulness of the project

	Useful	*Unsure*
Blended	3	1
On-line	1	2

4.3.2 Activity levels

Activity levels on both courses were tracked automatically by the Learning Content Management System (Moodle). There was a wide variety of activity level amongst the learners who completed the course, ranging from 26 records of activity to 199 (see Figure 3). Both of these learners completed the on-line version of the course. Interestingly, these levels also corresponded to the lowest and highest scores on the end-of-course test. Because of this, a spearman's rho test of correlation was carried out to see if there was a correlation between activity levels and test results, but no significant correlation was found at the 5% level (rho=.64; p =.12).

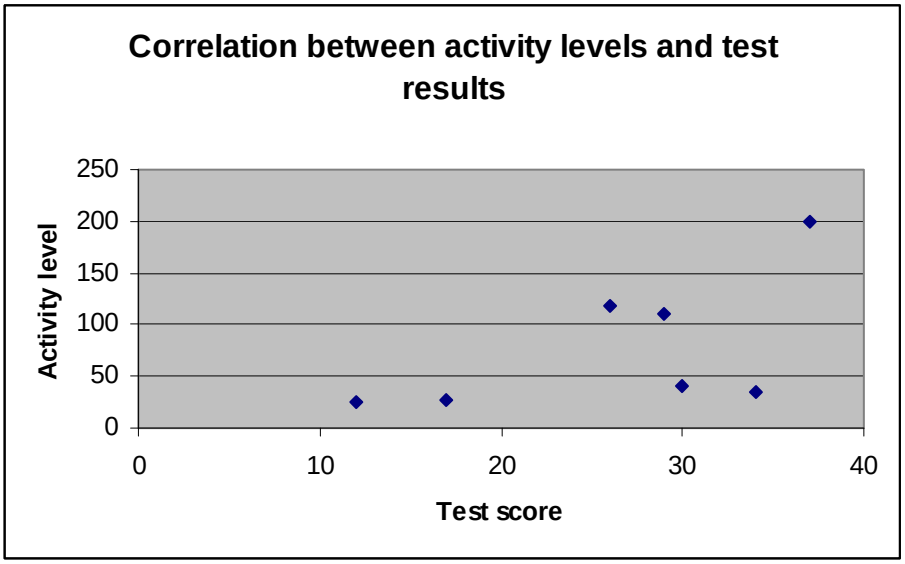

Fig. 3. Comparison of activity levels and test scores among both groups

Next, the use of provided resources was examined. All participants viewed the discussion forums and completed the first three lessons. However one member of the on-line group did not access the Activity Diagram or the Class Diagram lessons at all. Two members from the blended group and one member from the on-line group had a much broader level of interaction with the course. The learners' interactions with the course are illustrated in Figure 4. Note that the groups are shown in percentages due to the different size of the groups. All blended learning participants completed the

exercises in a class session, which accounts for their 100% completion rate in respect of exercises.

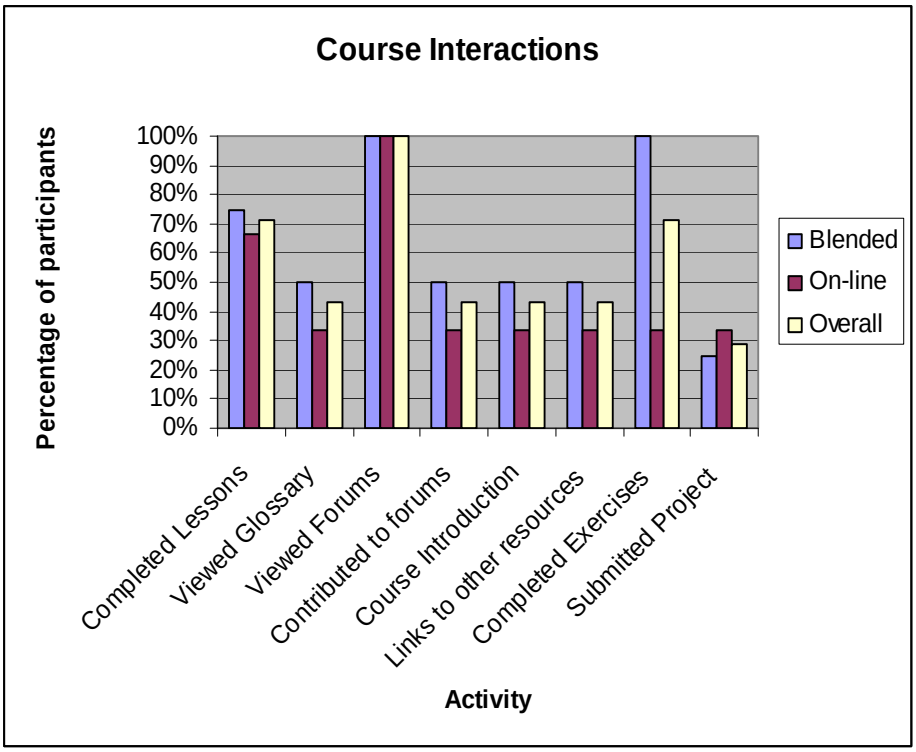

Fig. 4. Percentage of participants who participated in course the different course activites

4.4 Satisfaction

As outlined above, a Likert scale survey was used to measure satisfaction levels with the course. In order to get a fuller picture of the participants, they were asked to agree or disagree with a series of statements which could be indicative of their preferences for learning in groups or in isolation. This could have an impact on the learners' satisfaction with the collaboration activities available as part of the course.

Satisfaction with a course is not easy to define. By definition it is subjective, and a learner may be satisfied with certain aspects of a course while still retaining reservations about other aspects. Satisfaction with the course, for both groups, was measured by breaking it down into two sub-categories; ease of use and overall satisfaction with the course.

While the ability of the participants to recall knowledge of the learning outcomes was measured by the end-of-course test, this did not give any indication as to whether or not sufficient learning, to be applied to the workplace, was attained. Therefore, the

participants' perceptions of their learning and their confidence to apply it to their jobs were gathered.

Finally the effect of course design on the learners' likelihood to participate in a similar type of experience is examined.

4.4.1 Collaboration

Two separate issues were investigated under the category of collaboration. First of all, it was considered important to investigate whether or not the participants, in both courses, indicated a preference for learning in collaboration. Then, their attitudes about whether or not the course provided suitable opportunities for collaboration.

The statements in this section were included to determine whether or not learners had a preference for learning as part of a community or in isolation. The responses to these statements will have a direct impact on learners' satisfaction with the collaboration activities provided within the course. The learners' score for this category are illustrated in Figure 5.

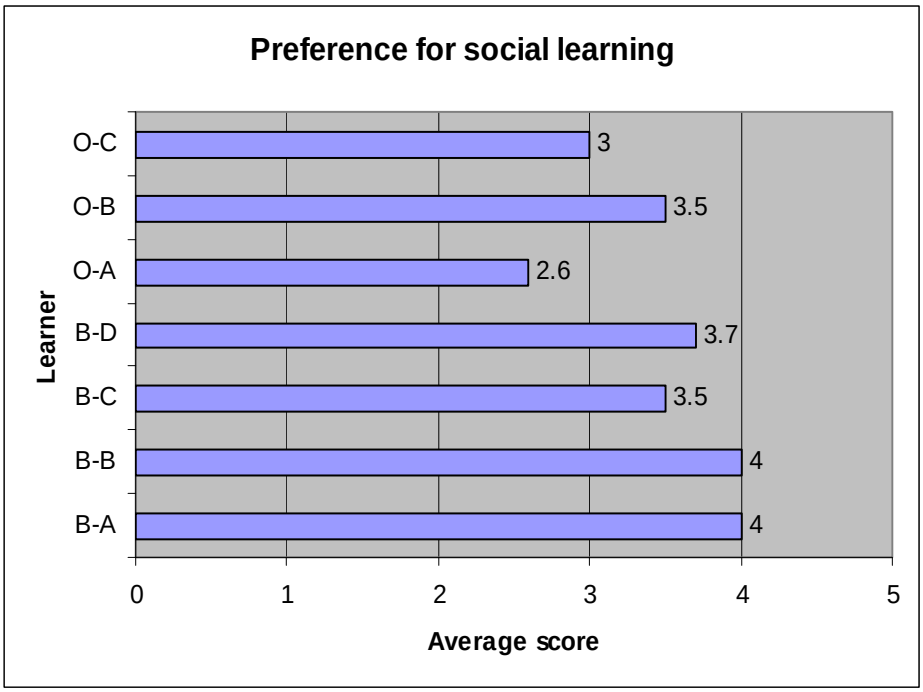

Fig. 5. Average score of participants in regard to statements on their preference for social learning

Three quarters of the learners in the blended learning group indicated a preference for learning in groups, while the on-line group were less sure. It would seem, therefore, that the learners in the blended version of the course were more likely to prefer collaborating with others while learning.

Looking at the graph, there is a clear difference in attitudes between the two groups when asked whether they prefer to learn in isolation or in discussion. However, examining responses to individual statements, the on-line only group were unsure whether or not they liked to discuss issues face-to-face with other learners but they all stated that they did not like to work out issues by themselves, without discussion with other learners. The blended learning group indicated that they liked face-to-face discussion as well as working out issues face-to-face. No conclusion therefore, may be taken from the response to these two statements (see Table 2).

Table 2. Responses to statements referring to the role of discussions (SA=strongly agree, A=agree, U=unsure, D=disagree, SD=strongly disagree)

	Blended Group				*On-line Group*		
Statement	B-A	B-B	B-C	B-D	O-A	O-B	O-C
I would like to be able to discuss issues face-to-face with other learners	SA	A	SA	SA	D	A	U
I like to work out issues myself, without discussion with other learners	A	U	SA	U	D	D	D

4.4.2 Ease of Use

How easy a course is to use, is an extremely important consideration when providing learning opportunities to employees. Six statements were provided to measure the participants' attitudes to the ease of use of the course. Responses were classified as easy, unsure or not easy and the number of such responses by each participant is shown in Table 3.

Table 3. Number of statements endorsed that refer to ease of use of the course

Participant	*B-A*	*B-B*	*B-C*	*B-D*	*O-A*	*O-B*	*O-C*
Easy	6	5	6	2	4	4	5
Unsure	0	1	0	1	0	2	1
Not easy	0	0	0	3	2	0	0
Total	6	6	6	6	6	6	6

It is clear that the majority of participants had no difficulty using the course, with just one exception in the blended learning course. This positive attitude, towards ease-of-use, could, in part, be explained by the fact that all participants are working in the software industry and should therefore have no difficulties in accessing the course. However, key to this research, is whether or not having face-to-face contact on a course impacts on the enjoyment of that course. Ease of use can be said to be directly related to enjoyment as, if a learner has to spend considerable time getting to grips with the course environment, this will have a negative impact.

4.4.3 Overall Satisfaction

On examination of the average scores for the satisfaction statements, no-one indicated that they were dissatisfied with the course although two out of the three on-line and one of the blended group participants came under the unsure category (see Figure 6). The remaining members of the blended group came definitely into the satisfied category. To try and pinpoint specific reasons for the difference in satisfaction levels, the responses to statements were examined on an individual level.

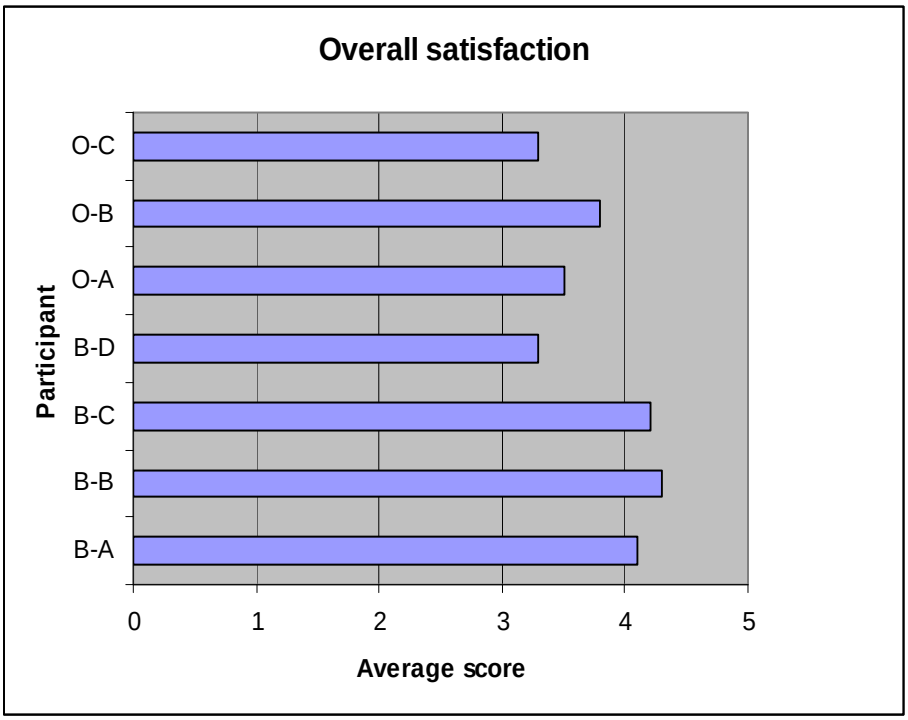

Fig. 6. Average satisfaction score

All participants, regardless of the group, indicated that the course met their needs and expectations and that they were not disappointed in the course. All but one participant indicated that they would recommend the course to friend and colleagues, felt comfortable with the learning environment and enjoyed completing the course, with the remaining participant unsure.

The same number of participants indicated that they would be interested in completing additional UML lessons, although in this case the remaining participant, from the on-line group indicated that they would not be interested in completing additional lessons. Interestingly when responses to the converse of this statement were examined, two of the on-line participants indicated that they would not be interested in completing additional lessons, where all of the blended group stated that they would. None of the participants felt strongly about this issue either way.

When it came to motivation to complete the course, one member from each group stated that they found it hard to motivate themselves to complete the course. The response was less positive when asked their opinion on whether or not the course could be described as excellent. Four participants agreed with the remainder being unsure. The responses were evenly spread across both groups.

The responses to the statements dealt with so far have been overall positive. However, three statements resulted in an overall negative response as shown in Table 4.

Table 4. Attitude towards statements with overall negative responses (SA=strongly agree, A=agree, U=unsure, D=disagree, SD=strongly disagree)

Statement	*B-A*	*B-B*	*B-C*	*B-D*	*O-A*	*O-B*	*O-C*
I would have preferred more opportunities for reassurance that I was progressing well	SA	D	A	A	A	D	A
I felt that I was learning in isolation	SD	D	D	A	A	U	A
I felt part of a learning community	A	U	SA	D	D	A	U

One weakness of the course identified, as offered to both groups, was the lack of opportunities for reassurance about progression on the course. However, if the course was held, whether on-line or blended, over a longer time-frame, the response could have been different. Only one participant of the on-line group attempted the exercises and project and while the blended group completed exercises in class, only one completed and submitted the project. As the exercises and project were the only formative assessment included in the course, it is hard to reassure learners that they are progressing well in the course, if they do not complete them.

While three out of four participants in the blended group did not feel that they were learning in isolation, two out of three of the on-line group did, with the remaining participant unsure. This would confirm previous studies which found that blended learning can improve the sense of community on a course (Dziuban, Moskal & Hartman, 2005; Stodel, Thompson & MacDonald, 2006), although the statement referring specifically to a learning community got a mixed response.

Overall, a high level of satisfaction with the course was recorded by both groups. The one area of difference concerned the sense of isolation experienced by the on-line group, which confirms previous research in this area.

4.4.4 Subjective Learning Gain

Measuring the learning gained on a course is not a simple task. Ideally performance on the job, resulting from participation in a course would be measured, but this is difficult to assess and was not possible in this case, due to the nature of the course design. The end-of-course test measured the participants' knowledge of the learning outcomes. However multiple-choice tests, and this one in particular, are essentially memory tests.

To support the test results, the participants were asked to indicate whether or not they felt they had learned the UML as a result of taking the course. Overall, five of the participants felt that they had learned on the course with one participant from each

group feeling unsure. No-one indicated that they felt strongly that they had not learned anything. In addition, there was no significant difference between the responses of the two groups.

Participants were asked to indicate their attitudes to five separate statements in relation to applying UML to their working environment. The response was overall very positive with six of the participants scoring an average over 3.5. The remaining participant came into the unsure category scoring 3.2 (see Figure 7).

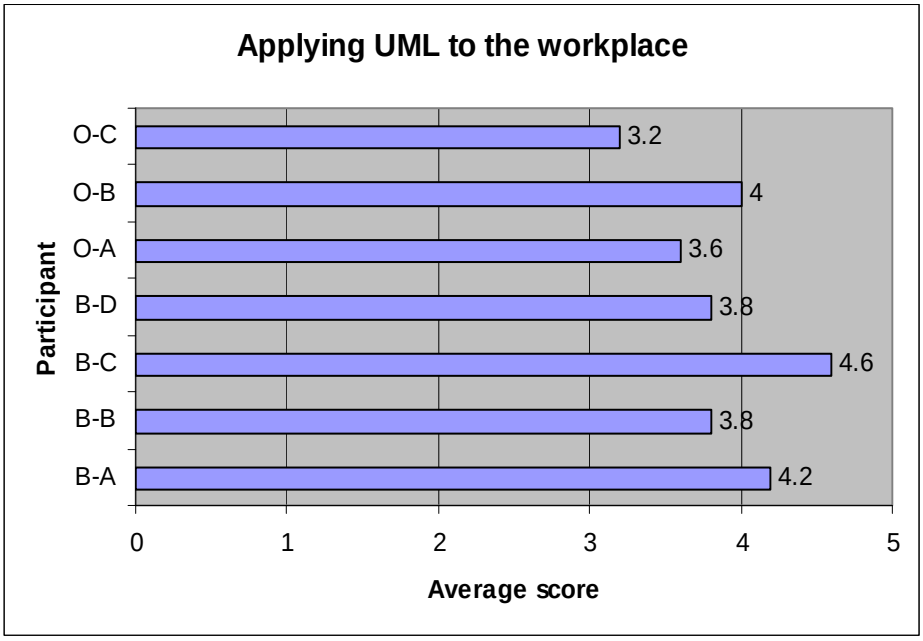

Fig. 7. Average score on statements referring to the participant's ability to apply learning to the workplace

However, when participants were asked if they felt that they needed further training before feeling confident enough to use UML on the job, there was a significant difference with the on-line group showing a much higher level of confidence in their abilities.

On the other hand, when asked whether or not their UML skills had improved, there was no difference between the groups. Overall, the response was positive with four of the participants agreeing or strongly agreeing that they had made a big improvement in their UML knowledge and skills, although three disagreed with this statement.

4.4.5 Course design

When it came to which course offered the better opportunity for learning, the responses were mixed with the blended group split 50-50 and all of the on-line group

being unsure whether they would have learned more if they had been members of the alternate group.

The general consensus in the blended group was that class attendance aided retention with the on-line group being more reticent about their responses (see Table 5).

Table 5. Attitude towards statements referring to the role of the classroom (SA=strongly agree, A=agree, U=unsure, D=disagree, SD=strongly disagree)

Issue	*B-A*	*B-B*	*B-C*	*B-D*	*O-A*	*O-B*	*O-C*
Would have learned as much if part of the other group	SA	D	SA	D	U	U	U
Class attendance aids retention	SA	SA	A	A	U	U	D
Class attendance increases motivation	A	SA	A	A	D	A	D
Would prefer a classroom only course	D	SA	SA	D	D	A	U

Most participants were happy with the version of the course they attended with six participants overall indicating that they would participate in a similar type course again. The one dissenter, disagreed strongly and was a member of the on-line group. This could be as a result of the self-selection process when being divided into groups, or it could be due to high satisfaction levels with both versions of the course.

When asked how they felt about the alternate course on offer, three out of four in the blended learning course were adamant that they would not participate in an on-line only course, with the on-line group again showing a mixed response.

Overall the blended learning group were more consistent in their responses, as a group, than the on-line group. This could be coincidental, but also could be indicative of a greater sense of cohesion in the group, as a result of meeting each other face to face. It is important to acknowledge though, that causation cannot be inferred from this type of survey.

In discussion with members of both groups, one issue that repeatedly came up was the large amount of material covered by the course in a short time frame. It was suggested that offering the course over a number months, rather than two weeks would have made it easier for the learners to absorb the knowledge and practice the skills needed in order to feel competent in the UML.

5 Discussion

Due to the small sample size, all interpretation of the data must remain preliminary. However, the data would suggest that the impact of the blend is not as significant as anticipated. Learners seem to be able to arrange with what they get.

However, when taking the number of people who agreed to partake in the experiment into account, it would support the theory that the inclusion of face-to-face sessions in a blended learning course has a positive impact on the completion rates of the course.

The test scores as an indicator of learning achieved are not in line with assertions by Garnham & Kaleta (2002), Matheos, Daniel & McCalla (2005), Cohen, Deege & Brewer-Frazier (2006) and Rosset (2006), that blended learning courses improve learning effectiveness. In fact the two highest scores on the test were achieved by members of the on-line group.

When reactions to, and use of, the on-line resources provided were analysed, the on-line group attached more value to the resources, in terms of their usefulness, than the blended group. However, the usage levels of these resources were poor for both groups.

While the data gained from this sample could be argued to be a reflection of the intended target population as a whole, further studies, with larger, more random sampling, would need to be undertaken in order to draw conclusive assertions about the effectiveness and enjoyment of blended learning as opposed to on-line only learning.

Acknowledgements

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