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A multivariate analysis of secondary students' experience of web-based language acquisition

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Abstract

This paper reports on a large-scale project designed to replicate an earlier investigation of tertiary students (Felix, 2001) in a secondary school environment. The new project was carried out in five settings, again investigating the potential of the Web as a medium of language instruction. Data was collected by questionnaires and observational procedures to ascertain student perceptions of the usefulness of Web-based learning, their views on its advantages and disadvantages, their personal comfort and enjoyment when working with the Web, their preferred mode of delivery, their evaluation of the quality of resources used, and their learning styles and study preferences. Results of both studies showed that students were on the whole positively inclined to working with the Web and found it useful, with the majority preferring to use the Web as an add-on to face-to-face teaching. Reported advantages in both studies outweighed disadvantages. The secondary students felt significantly more comfortable on the Web, worked longer hours and reported more evenly distributed study preferences. Most favoured a kinesthetic learning style and significant relationships between learning style and mode preference were found. Differential findings related to gender emerged in the two studies.

1 Introduction

During the last decade numerous studies have emerged investigating perceptions of, and attitudes to, learning in online environments. A quick search of the relevant literature related to language learning revealed no fewer than 45 studies over the last three years alone. Most of these are concerned with responses to individual programs (Elgort *et al.*, 2003; Kung & Chuo, 2002; Hémard & Cushion, 2001; Cabot, 2000) and the use of communication facilities such as email, chat programs or discussion groups (Greenfield, 2003; O'Dowd, 2003; Tudini, 2003; Belz, 2002; Sengupta, 2001; Darhower, 2000). A smaller number also investigated the role of the teacher (Stepp-Greany, 2002; Wang & Sutton, 2002; Tognozzi, 2001); students gaining computer literacy (Egbert *et al.*, 2002), multiliteracies (Kasper, 2000) and metacognitive knowledge and skills (Hauck, 2003; Kasper, 2000); reactions to multimodal approaches (Strambi and Bouvet, 2003; Ushida

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and Thomson 2003; Rogers, 2002) and learning in virtual communities and virtual worlds (Shield & Hassan, 2003). While reported findings are varied, reflecting the many topics of investigation, general trends have emerged. On the negative side there are still concerns about technical difficulties interfering with the learning process; older students not feeling comfortable with computers; younger students not possessing the necessary metaskills for coping effectively in these challenging environments; training needs in computer literacy for both students and teachers; problems with group dynamics; and time constraints. On the positive side salutary effects on motivation, computer literacy, target culture awareness, reading and listening skills, and classroom climate in terms of enjoyment and comfort have been observed. Apart from rare exceptions (Kannan & Macknish, 2000), the bulk of the literature confirms the Web and the Internet as viable environments for language learning for students in tertiary settings provided the constraints above are addressed. There is also an increasing trend towards suggesting the use of the new technologies in 'blended learning' environments (Neumeier, 2003; Wolff, 2003), in which e-learning and learning face-to-face are combined and based on the same pedagogical approach, recently tending towards a social constructivist model.

In terms of online language learning in school environments, however, very little research has to date been conducted. Our search revealed only two studies. One concerned the use of email to collaborate on language learning projects with students at another school (Greenfield, 2003), the other evaluated methods of delivering course material for distance education for schools in remote areas (Edmonds, 1998). Findings in each case were very positive with students strongly supporting the program, being motivated and finding the experience to be fun.

In order to contribute new insights to this small body of work, it was decided to replicate a complex multivariate study, conducted with tertiary students (Felix, 2001), in a secondary environment. This study had on the whole confirmed findings reported to date and since but also investigated new variables, such as learning strategies, the use of graphics, time on task, delivery mode, study preference, age and gender. Significant differences for age and gender were found relating to clarity of objectives, number of hours worked, mode of delivery, perception of comfort and appreciation of graphics. Very few significant findings relating to strategy strength emerged. For this reason we decided to investigate learning styles in this current study. What was most surprising was the high percentage of students opting for using online materials in class. The other options were using materials 'alone in addition to face-to-face teaching', 'by distance with a tutor', and 'by distance without a tutor'. Predictably the last was the least preferred option. More detail on the findings can be found in the Result section below.

The purpose of the new investigation was to:

- gauge how comfortable secondary students feel about working in a Web-based environment, whether they enjoy it, and whether perceptions change after prolonged use.
- determine whether students find it useful to work with Web-based materials, which elements they find most useful for language learning, how they perceive the advantages and disadvantages of Web-based learning compared to conventional learning, and which mode of delivery they prefer.
- discover which learning style strengths might typify good Web-based language

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learners, and whether study preference (working alone or with others) makes a difference to perceptions.
- investigate potential differences relating to gender in the way all variables are perceived.
- investigate possible differences in perceptions between the tertiary subjects participating in Study 1 and the secondary subjects in Study 2.

2 Method

2.1 Participants

As with the previous study, an invitation to participate was included in as many relevant professional publications and discussion lists as possible worldwide. While copious responses were received, many of them were from institutions teaching the wrong age-group and not all interested colleagues ended up participating. The reasons most often given were lack of time, or that students had not used resources sufficiently to comment adequately. Final participants were five schools, one in Poland teaching EFL, three in Melbourne teaching Japanese, Spanish and French, and one in Brisbane teaching French and German.

Sixty percent of the participants were female and 40% male. This was a more even distribution that in the first study (75% and 25%), but females still out-numbered males significantly. Because all participants in this study were secondary school students the age range was smaller than for the first study (18–75), ranging from 13 to 20. Three major language backgrounds were represented: 44% English, 34% Spanish and 21% Polish. The group of Spanish speakers were children who were born and educated in Australia but still considered their native language to be Spanish because it was spoken in the home. This was also the case for subjects in the previous study in which 54% specified a language other than English as their native language.

2.2 Materials used

As in the previous study, the Web-based activities differed slightly between the schools, but on the whole the online materials in the present study were less structured than in Study 1 and consisted of task such as:

- Creating on-line quizzes in the target language.
- Participating in chatrooms and discussion groups.
- Engaging in listening and reading comprehension tasks.
- Completing task-based cultural projects based on Websites.
- Writing emails in the target language.
- Working through interactive language exercises (in one school built into WebCT).

2.3 Procedure

The study was conducted during 2001/2, following identical procedures to the previous study (carried out in 1999), with each group participating over approximately 11 weeks.

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Students' consent to participate was sought through statements of intent that were handed out or emailed. Students were asked to complete three different questionnaires on three separate occasions online, using their own name or an alias. The questionnaires were changed or refined in the light of the experiences and findings in the first study. They can be viewed at: http://www.arts.monash.edu.au/lc/sill/. The major change was substituting a learning styles questionnaire for the strategy one used in the first study. The reason for this was that no significant results had been found related to strategies in the previous study. This was also the case in a pilot study we ran in 2000 which included 62 secondary students.

3 Questionnaires

1. *Perceptual Learning Style Preference Survey* (Joy Reid)
   The relationship between learning styles and perceptions was a new element in the current study. As in the previous study we were only interested in broad correlations, such as 'Do learners who favour a visual learning style find Web-based learning more useful?' For this purpose we used an instrument which calculates a score out of 50 to determine which of six perceptual learning styles (visual, auditory, tactile, group, kinesthetic, individual) were favoured by the participants.

2. *Web Experience/Perception Questionnaire* (designed by the author)
   This questionnaire was substantially the same as for Study 1 with two changes. The first was the addition of questions to ascertain for which of six aspects of language learning the Web was most useful. The second was an enlargement from 4 to 5 of the scale used to indicate recommendations about how best to use Web materials in terms of mode. In Study 1 we had intended respondents to rank the four modes in order from 1 (worst) to 4 (best), but found that many students gave an equal rating to more than one mode. It was decided that a 5 point Likert scale, in line with the scale used for most other measures in the study, would be more appropriate.

3. *Resource Evaluation* (adapted from Gregor Kennedy's Cal Evaluation)
   Experience in Study 1 indicated that this questionnaire was too long and contained some duplication, so it was decided that the number of questions could be reduced without compromising the value of the responses. Categories which did not yield discerning information were dropped, and the number of questions in each of the remaining categories was reduced to three key ones. As in Study 1 our main interest was to gauge in a very broad way students' impressions of the quality of resources so that their responses to the second questionnaire could be put into perspective.

4 Data analyses

As in the previous study, Univariate analyses of variance were used to identify any significant relationships between selected variables. Tukey HSD post hoc tests were then used on significant relationships to determine where the significant differences lay.

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Correlation analyses, nonparametric tests using two independent samples, and t-tests were also used where appropriate. Eighty-two valid responses were received for the first and second questionnaires and 48 for the third. Most analyses reported below contain 80 subjects, while those related to quality of resource contain 48. This is compatible with the return rate of responses in Study 1. To conserve space, tables for statistical analyses are not included, but levels of significance (set at $p < 0.05$) are given on each occasion. The full documentation is available from the author.

5 Results

5.1 Quantitative data

5.1.1 Mode of delivery and study preference

Students were asked to rank on a five point scale four modes in which language learning materials might be used on the Web:

1. As an addition to face-to-face teaching used in the classroom.
2. As an addition to face-to-face teaching used in the students' own time.
3. As a distance learning resource used without access to an on-line tutor.
4. As a distance learning resource used with access to an on-line tutor.

More than half the respondents (57.8%) considered that the best way to use Web materials was in class as an addition to face-to-face teaching, and the least preferred mode was distance learning without access to a tutor. These findings were almost identical to those of the previous study. The current study did not confirm the previous finding that non-native speakers of English had a greater preference for option 1 than native speakers.

There was a significant difference in study preferences between the two studies ($p = 0.035$). While there was an even distribution of preferences in the current study, with 36.3% of students choosing to work alone, 32.5% preferring to work with a partner and 31.3% preferring to work in a group, 44.4% of participants in Study 1 preferred to work in a group and only 20.6% preferred to work alone.

5.1.2 Comfort, enjoyment and usefulness

Students were asked to indicate on a five point Likert scale how true statements about feeling comfortable with, and enjoying learning on, the Web were for them. While a large number of students were already comfortable with the Web at the start of the study (81.6% giving a score of 4 or 5), an even greater number were comfortable at the end of the study (88.8%), with 66.3% giving the highest score of 5. English speakers were more comfortable at the start than their non-English speaking counterparts ($p = 0.043$). Those feeling uncomfortable (giving a score of 1 or 2) dropped from 9.2% to just 5% (Table 1). These findings differed significantly from those of the previous study where as many as 17.5% had claimed to feel uncomfortable at the start, dropping to a low 3.2%, and initial scores for feeling comfortable rose from 57% to 73%. A possible explanation for the differential results in the two studies may be the fact that the current

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study had younger participants who tend to be more computer-literate than their older counterparts.

Half the current participants (slightly fewer than in Study 1) enjoyed using the Web at the start, and this increased to 63.8% at the end of the study. As with the previous study, the improvement for both comfort and enjoyment was highly significant ($p = 0.000$). Sixty percent of students indicated that they found using the Web for language learning useful, again slightly fewer than in Study 1.

5.1.3 Relationship between perception of comfort/enjoyment and usefulness

The analysis showed a strong link between students finding the materials useful and their feelings of enjoyment both at the start and at the end ($p = 0.000$) of the study. There was also a significant relationship between usefulness and comfort at the end of the study ($p = 0.035$) but the link with comfort at the start was not significant. These results differed from those of the first study where the relationship between comfort at the start and usefulness was strong, but there was no link with enjoyment at the start. These differences are difficult to interpret but suggest that younger students find materials more useful if they enjoy the experience while adult students need to be comfortable when using Web resources.

5.1.4 Usefulness related to language skills

In this study we had a more detailed breakdown to determine for which particular aspects of language learning the Web was most useful, vocabulary learning (47.6%) and writing (45.1%) were clearly ahead, while 50% of students judged Web learning not to be useful for speaking (Table 2). This, of course, is not surprising since no audio-graphics, allowing students to speak online, had been used in any of the schools.

5.1.5 Relationship between comfort, enjoyment and length of study

Contrary to the findings of Study 1, results here showed no significant correlation between the length of time students had spent learning the language they were studying and their feelings of comfort and enjoyment either at the start or the end of the study period. This finding appears to support the general view that younger students are less inhibited as beginning language students. Another explanation might be that most sec-

Table 1. *Comfort, enjoyment and usefulness*

	Comfortable at start (%)	Comfortable at end (%)	Enjoy at start (%)	Enjoy at end (%)	Useful (%)
Never true	2.6	2.5	11.5	6.3	6.3%
Generally not true	6.6	2.5	17.9	13.8	17.5%
Somewhat true	9.2	6.3	19.2	16.3	16.3%
Generally true	34.2	22.5	33.3	32.5	41.3%
Always true	47.4	66.3	17.9	31.3	18.8%

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Table 2. *Usefulness related to language skills*

	Useful Generally	Vocab	Grammar	Writing	Speaking	Listening	Pronounce
Never true	6.3	7.5	8.8	13.8	26.3	17.5	27.5
Generally not true	17.5	15.0	22.5	20.0	23.8	22.5	17.5
Somewhat true	16.3	30.0	27.5	21.3	23.8	25.0	17.5
Generally true	41.3	23.8	27.5	28.8	17.5	17.5	22.5
Always true	18.8	23.8	13.8	16.3	8.8	17.5	15.0

ondary school-aged students are quite computer literate and the technology itself is less of a novelty and presents less of a challenge to them than it did to the more mature respondents of Study 1, especially considering that the previous study was carried out in 1999.

5.1.6 General satisfaction with web materials used

Students were asked to indicate their general satisfaction with Web learning on a 9 point Likert scale. They gave ratings for how engaging, appealing, interesting, user-friendly, enjoyable, relevant, logical, challenging, boring or confusing they found the materials. The mean for each aspect ranged from 5.09 to 5.79 (with boring and confusing reversed), and the mode for all aspects except boring was 5.0, indicating that the majority of students were moderate in their appraisal of the programs they were using. This appraisal was significantly less favourable than in Study 1 with lower ratings for whether the materials were engaging ($p = 0.004$), interesting ($p = 0.003$), user-friendly ($p = 0.017$), valuable ($p = 0.000$), enjoyable ($p = 0.001$), relevant ($p = 0.000$) and challenging ($p = 0.001$). In Study 1 the mean for these same aspects ranged between 6.08 and 7.33. One possible reason for the difference may well be that younger students are more used to accessing Web resources, and that they may have judged these educational materials against more exciting game-oriented resources.

An analysis of which aspects of the Web materials contributed to the perception of their usefulness showed that the most important were meaningful feedback ($p = 0.001$), clear and logically organized content ($p = 0.020$) and easy navigation through the program ($p = 0.045$) which supported the findings of the previous study. Unlike Study 1, however, there was no link between clear objectives and usefulness.

5.1.7 Relationship between number of hours spent on the web and other variables

As in Study 1 most participants spent between 5 and 30 hours working with the Web materials. A large percentage (38%) worked for about 10 hours. However, 20 % said they spent more than 100 hours online. Overall students in the current study spent significantly more hours online ($p = 0.002$) than those in the previous study. The reason for this difference might have been that the participants in the current study were more at ease with computers, and may have had easier access to computers and more time than

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their adult counterparts. As in the previous study, non-native speakers of English spent significantly more hours on-line than the native speakers (p = 0.000). Unlike Study 1 there was no statistically significant relationship between hours spent using the resources and students' feelings of comfort or enjoyment. Nor did their evaluation of the Web resources correlate with how much time they spent using the materials.

5.1.8 Learning style preferences

The perceptual learning style preference survey calculates a score out of 50 to determine the major learning style preference. The scores are interpreted as follows:

38–50 = Major learning preference
25–37 = Minor learning preference
0–24 = Negligible learning preference

The majority of respondents had more than one style preference with 30.5% having three major style preferences. 23.2% had only one style preference, and 6.1% had no major preference at all. By far the most common major style preference overall was kinesthetic, with 62.2% of respondents stating this to be one of their major preferences. (Reid (1998) defines this style as learning by experience, by being involved physically in classroom experiences, by remembering information well when actively participating in activities, field trips, and role-playing in the classroom. A combination of stimuli – for example, an audio-tape combined with an activity – will help understand new materials.) The least common major preference was visual with only 19.5% claiming this as one of their majors (Table 3). It is interesting to note, however, that visual was strongly favoured as a minor learning style together with auditory.

Where respondents had only one major style preference, 42% had group as their major style. Tactile style was not a major preference for anyone with only one major. More native English speakers had tactile (p = 0.026) and kinesthetic (p = 0.011) as a major learning style preference than non-native speakers of English.

5.1.9 Relationship between learning style preferences and other variables

Analyses were conducted to investigate the differences in the ratings of usefulness, enjoyment and level of comfort with Web learning as they related to the different learning styles used. The analysis did not support the hypothesis that certain learning style preferences will have an effect on how useful students perceive Web learning to be.

Table 3. *Language learning styles used*

	Kinesthetic (%)	Group (%)	Individual (%)	Auditory (%)	Tactile (%)	Visual (%)
Major	62.2	46.3	36.6	30.5	28.0	19.5
Minor	32.9	34.1	41.5	65.9	48.8	64.6
Negligible	4.9	19.5	22.0	3.7	23.2	15.9

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This study also investigated for which particular aspects of language learning the Web was most useful. There was only one significant relationship ($p = 0.040$) between learning style preference and usefulness: those whose major learning style preference was auditory considered Web-based learning more useful for learning vocabulary than did those with this style as a minor or negligible preference.

The relationship between group as a major learning style preference and a study preference for working in a group was predictably highly significant ($p = 0.000$), as was that between individual as a major and a study preference for working alone ($p = 0.000$). These results support the reliability of the data.

Three learning style preferences showed a significant correlation with the preferred modes of delivery:

- Individual learning style correlated with using the Web materials alone in addition to face-to-face teaching ($p = 0.031$).
- Group learning style correlated with using the Web materials for distance education with access to a tutor ($p = 0.041$)
- Kinesthetic learning style correlated with using the Web materials in class in addition to face-to-face teaching ($p = 0.004$) and also with using the Web materials for distance education with access to a tutor ($p = 0.044$).

5.1.10 Relationship between gender and other variables

Analysis of variance showed five significant differences between males and females. Males rated clarity of objectives more highly than females ($p = 0.033$). This was consistent with the findings in Study 1 and equally difficult to interpret. Females found the Web materials more useful for writing ($p = 0.029$), speaking ($p = 0.036$) and pronunciation ($p = 0.046$). Also, more females (38.8%) than males (18.2%) had an auditory learning style preference as one of their majors. The findings in the previous study – that males worked longer hours with the materials and preferred using them in the face-to-face option – were not supported here.

6 Qualitative data

Participants were asked to identify what they saw as the main advantages and disadvantages of using Web-based programs for language learning. As in the previous study, identified advantages outnumbered disadvantages. To conserve space we have categorized answers into representative headings; full transcripts are available from the author. The majority of comments reflected those made by the adults in the previous study. However, there were a few interesting differences, some of which shed light on the differential findings reported above. In the list below we have marked identical categories in *normal italics*, the category arising out of the new study in **bold**, and categories exclusive to the previous study in *[brackets]*.

Advantages (44)

- *Time flexibility*
- *Wealth of information*

Disadvantages (28)

- *Lack of speaking practice*
- *[Distraction]*

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- *Reinforcement of learning*
- *Privacy*
- *[Ability to repeat exercises]*
- *[Gaining computer literacy]*
- *[Absence of teacher]*
- *No interaction with peers*
- *Inadequate feedback*
- *Absence of teacher*
- ***Health risks***
- *Technical difficulties*

While most comments were predictable, a few interesting observations can be made. The fact that the younger students singled out health risks ('after 2 and half hours my eyes are tired', 'when you are sitting too long you feel tired', 'I must spend a long time looking on a screen and that is not healthy' and so on) is clearly related to them having spent much more time using the materials. They may also have continued using computers at home and these comments may well have reflected their parents' view. Not commenting on being distracted or gaining computer literacy appears to support the speculative interpretations above that younger students are already fairly computer literate and at ease in an online environment.

Further significant differences were found within the categories technical difficulties and anonymity. In Study 1 only 6% of the students had commented on technical problems, whereas here 17.5% did ($p = 0.046$). There are several explanations for this. First, younger, computer-literate students may have higher expectations of reliability; secondly, laboratory facilities in universities tend still to be better than in secondary schools; and thirdly, we had eliminated an entire group because of excessive technical problems in the earlier study. Had they been included, results may have been quite different. What the results suggest very strongly, however, is that technical problems are still a concern not to be ignored. In terms of perceiving anonymity as a positive element of online learning, it is interesting to note that this perception was significantly higher (11%) among the adults than among the school-aged students (4%; $p = 0.035$). This finding lends some support to the interpretation above that younger students feel less awkward performing with imperfect language skills.

7 Discussion

The findings of the current study largely support those of the previous one, again confirming the Web as a viable environment for language learning, especially as an add-on to face-to-face teaching. What can be said without hesitation is that both tertiary and secondary students were on the whole positively inclined to working with the Web and found it useful, and that identified advantages outweighed disadvantages in both groups. In both studies non-native students worked longer hours online than their native speaker counterparts. What also emerged very strongly was that the younger students worked longer hours on the Web and felt even more comfortable using the technology than the adult cohort. Despite the already higher ratings, a significant improvement over time was again found for comfort and enjoyment, which refutes unfounded speculations about novelty effects in computer-assisted learning environments.

It was also interesting that the school-age students identified the same three elements as the adults – *meaningful feedback, logically organized content, easy navigation* – as important contributors to their perception of the usefulness of materials, again supporting good design principles. The adults had also found clear objectives to be important.

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This difference can most likely be attributed to the less structured format of the materials used in the current study where students were not necessarily given a clear statement of the objectives; but it may also have to do with the fact that adult students are generally more interested in the objectives of learning materials.

Before discussing differences in detail, however, it is necessary to look at limitations in terms of validity of the comparative data. First, students in the two studies did not use identical materials; secondly, data for Study 2 was collected two years after the first study; and thirdly, the secondary students worked significantly longer hours with their Web materials. Some comparative findings, therefore, need to be seen in the light of these limitations.

It is interesting to note that our speculation in Study 1 that students may have been especially enthusiastic about Web-based language learning because they had rated the resources exceptionally highly was not confirmed here. In the current study ratings for comfort and enjoyment were generally even higher than in the previous one, despite lower corresponding ratings for the quality of resources. There was also some indication that younger students find materials more useful if they enjoy the experience while the adults' perceptions of usefulness were linked to their feeling of comfort.

These findings lend some support to the speculation that younger students are on the whole more comfortable in a Web-based environment, and possibly also in a language learning environment, and that they may have high expectations of the quality of computer resources, although it is difficult to judge whether younger students' perceptions of quality may not be more influenced by 'bells-and-whistles' effects. The fact that resources in both studies were fairly conservative when compared to the latest computer games may well have led the younger students to rate them significantly lower than the adults. The finding that despite this the younger students enjoyed the experience even more than the adults may have to do with the fact that most younger students enjoy working and playing with computers. Another reason could have to do with the timing of the studies. High quality Web resources for language learning were quite rare in 1999, which may have led the tertiary students to judge them more favourably than they might have three years later.

The decision to substitute a learning style questionnaire for the strategy one used in the earlier study proved to be worthwhile. While no interesting findings emerged in Study 1 relating to learning strategies, quite a number of notable findings were shown in Study 2. Naturally it would have been most interesting to investigate both learning strategies and styles in this last study, but we were reluctant to increase the number of questionnaires by yet another substantial one. In general the new findings were clear and supported the literature (Reid, 1998). Kinesthetic was favoured as the strongest major learning style, and visual as the least. The latter, however, was very strongly favoured as a minor learning style, as was auditory – a combination that seems ideal for working with multimedia applications.

While there were no significant relationships between learning styles and students' perceptions of usefulness of materials, interesting correlations between learning styles and mode preference were found. Students who favoured the *individual* learning style preferred using the materials on their own in addition to face-to-face teaching; those with *group* as their major singled out distance learning with a tutor as their preference, and those with a *kinesthetic* major chose both distance learning with a tutor and using

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the materials in class as their preferred options. These last findings are particularly interesting since they suggest that students with other than an *individual* learning style prefer an environment that somewhat resembles the sense of community that may characterize their classroom experience. While there appear to be no objections to learning by distance *per se*, the option without a tutor found no support in the present study and was favoured only by those students in the previous study who had chosen to learn by distance.

The strong general conclusion to be drawn from our quantitative investigations is that the Web is potentially a viable medium for language learning. This conclusion is supported by the fact that in the qualitative data, reported advantages outweighed disadvantages to a great extent. In saying this, we emphasize that we are here talking about online learning in a broad sense. The participating students were engaged in a variety of approaches to Web learning; all had access to a teacher, either face-to-face or by e-mail; and the majority were using the Web, not on its own, but as an additional resource to face-to-face teaching. While the findings lend strong support to those advocating a blended learning approach, it would be most interesting to replicate the study in an exclusively distance learning environment.

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