# ALICE In Online And On-Campus Environments – How Well Is It Received?

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## Abstract

Since its launch around 2000, Alice, an innovative tool to aid in the teaching of introductory programming, has received much publicity and great acceptance worldwide. It has however, also received a number of criticisms, and in some cases, was even removed from the curriculum. Further researches are needed to establish more precisely what works and what does not work for Alice, and in what situation. This paper reports on the outcomes of an educational empirical research project that aims to establish if there are any correlations between the level of acceptance of Alice by students and the learning environments (online versus on-campus), taking into consideration the specific characteristics of Alice as well as the personal traits, learning style, and relevant background and experiences of the students. The findings indicate that is more likely that online students like Alice than on-campus students. This deviation however, is not likely to be influenced by the learning environment or study mode per se, but rather by age, communication frequency, and English as the first language.

**Keywords:** Alice, introductory programming, computer science education, online learning environment.

### 1. INTRODUCTION

Alice is an innovative programming platform, launched by Professor Randy Pausch and his team around 2000 (Pausch 1995; Cooper 2000). This software, aimed to aid in teaching introductory programming, offers a revolutionary approach, using 3-D interactive graphics and animation. It has gained much publicity, wide acceptance and great appreciations globally (Moskal 2004; WebWire 2007; Alice.org(a) 2010; Alice.org(b) 2010; Salim 2010), however has also received some criticisms (Cliburn, 2008, McKenzie, 2009). Further research is necessary to establish more precisely what works and what does not work for Alice, and in what situations.

At RMIT University, it is felt that online students accept the tool better than on-campus students. The *null hypothesis* is thus that there is no difference between the level of acceptance of Alice between online and on-campus students, and the *alternative hypothesis* is that there is a difference. This paper reports on an empirical educational research project that aims to confirm or reject the null hypothesis, and also establish factors that may relate to this deviation. To this end, the following key research questions have been investigated:

1) Is Alice better accepted by online students than on-campus students and to what extent?

2) Why is the difference, if any? What factors in the learning environments, features of Alice and students' characteristics may contribute to this deviation?

We surveyed the students at RMIT University who did Introduction to Programming in either online or on-campus mode during the period between 1/8/2010 and 30/10/2010. Students' acceptance of Alice is captured the question, "In general I like learning programming with Alice." Another question, "I think it is necessary to use Alice to teach introductory programming to beginners", may also be used as a secondary measure of students' acceptance of Alice. We call the first question the *primary question* and the second one, the *secondary question*. These two questions are criteria 26 and 27 of question 15 in the survey (see Appendix A).

Statistical analyses including multi-variate analyses (Blaikie 2003) were carried out to identify and measure the influence of the factors that may be associated with students' attitude towards Alice. Qualitative analysis, mainly based on the open-ended questions, was also used to validate the conclusion reached by quantitative analysis (Marshall and Rossman 2011).

The possible outcomes of the project are the confirmation or rejection of the hypothesis, and establishment of a correlation between Alice and the study environments, if any. The project will make a meaningful contribution to the existing knowledge about this new tool Alice. It can help educators to adjust their teaching tools and methods, and/or design course curriculum, for the benefit of the students and ICT industry. It may also contribute to human understanding on the different characteristics relating to online and on-campus learning.

## 2. CONCEPTUAL FRAMEWORK

Teachers in introductory programming are very well aware of the difficulties many beginners encounter in learning computer algorithms and programming concepts because they cannot figure out the steps a computer program takes to solve a problem (Cooper 2000). To address this issue, visualisation has long been used to animate the program execution and proven helpful (Maxim and Elenbogen 1988; Shu 1988; Stasko 1992). Alice takes visualisation to a different level by providing a 3-D, animated, interactive environment, where students can create their own virtual world. It has gained much publicity, apparently many positive results and wide acceptance (Alice.org(a) 2010; Alice.org(b) 2010; Moskal 2004; WebWire 2007; Salim 2010).

However there have also been mixed results – to the point that Alice's benefits to students are too mixed to justify keeping it in the curriculum (Cliburn 2008) and criticisms – mainly because it is not a commercial tool and cannot be used professionally (McKenzie 2009). To our knowledge, none of the studies so far have aimed to identify the elements that contribute to the mixed results; in particular, the element of the learning environment has never been studied. The possible deviation of students' attitudes toward Alice between online and on-campus learning environments is of interest because of the particular characteristics pertaining to the online environment, which are well studied in the literature (Palloff 2001; Bernard 2004; Kerr 2006; Liu 2006).

This research, informed mainly by the literature of Alice, online teaching, and computer science and information technology education, does that comparison (between the online and on-campus learning environments), taking into account not only the attributes of these environments, but also those of the student and Alice. It is hoped to detect if there are discernible differences in students' acceptance level of Alice in the two differing learning environments, and if there are, how the attributes in Alice, the learning environment and the student, might contribute to such differences.

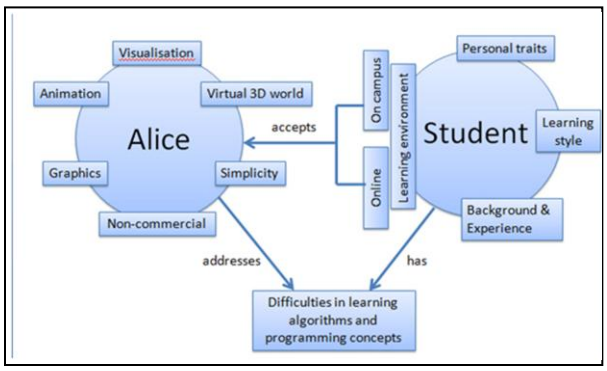


**Figure 1: Concept map for conceptual framework**

Fig. 1 above shows a concept map of the conceptual framework used in this research. The two main subjects of this research, Alice and the Student in two different learning environments, are carefully investigated with questions that probe into their many specific characteristics, as they interact with each other to address the common issue of difficulties in learning algorithms and programming concepts.

## 3. FINDINGS AND DISCUSSION

The two student cohorts (online and on-campus) differ mainly in language, international vs. local, age, programming experience, communication methods, being good at drawing, and being influenced by the fact that Alice is not a commercial tool. Differences are also found in their ratings of the various features of Alice.

40% of the on-campus students vs. 91.1% of the online students have English as their first language. 60% on-campus students are international, but all online students are local. Only 10% of the on-campus students are mature age (over 25) compared with 75.6% in the online cohort. 40% of on-campus students vs. 83.3% of online students have done some programming before. (See Fig. B1 & B2 in Appendix B).

As expected, the main communication method for on-campus students, on one hand, is overwhelmingly face-to-face; followed by other online communication means, phone, email, Blackboard forum, Blackboard or Elluminate chat, and Blackboard blog or wiki. Online students on the other hand, use primarily Blackboard forum, followed by Blackboard or Elluminate chat, Blackboard blog or wiki, other online communication means, email, and phone. There are more on-campus students who say that they are good at drawing, and more online students being influenced by the fact that Alice is not a commercial tool. Generally the online students give higher ratings to the various features of Alice.

We have assigned values between 0 and 4 to the ratings in the survey questions 9 (communication method) and 15 (criteria statements) to compare the average ratings of the two cohorts, where 0 corresponds to "strongly disagree" or "never", and 4 to "strongly agree" or "5-6 times or more". These rating tables (B1 to B8) are included in Appendix B.

In both cohorts most students classify themselves as undergraduate, and the male / female ratios are similar (30% female on-campus vs. 24.4% online – see Fig. B1 to B3 in Appendix B).

When cross-tabbing the variables of the primary and secondary questions with various variables, we find that, of the differences in the two students cohorts, only language, age, communication methods, and the features of Alice have significant associations with the liking of Alice (see Quantitative Analysis below).

The response rate is 17% for both online and on-campus student cohorts, with 45 out of 258 online, and 10 out of 58 on-campus students responding. Even though this is a bit higher than expected, the sample size for the on-campus population is quite small, and may have implications in the interpretation of some findings. The interpretation suggested here therefore, should be taken with reservation. We do not think that the small sample size of the on-campus cohort is due to the fact that the on-campus students are less mature in age, because the response rate is actually the same for both groups.

The difference in students' attitude towards Alice between online and on-campus student cohorts however, is clear. 53.5% online versus 11.11% on-campus students choose "Agree" or "Strongly Agree" to the primary question. Likewise, 54.2% online versus 22.22% on-campus students choose "Agree" or "Strongly Agree" to the secondary question. Moreover, only the online students choose "Strongly Agree" in both questions. (See Fig. B4 & B5 in Appendix B).

Assigning numerical values of 0 to 4 to the responses, where 0 corresponds to strongly disagree and 4 to strongly agree, we are able to run T-Test for the two student cohorts, and obtain p=0.013 for the primary question and p=0.045 for the secondary. Both values indicate that the differences in the two groups are significant (with the online group showing a higher level of acceptance of Alice). That is, *the alternative hypothesis is confirmed*.

Below are more analyses to answer the research question 2. That is, why is the difference? What factors in the features of Alice, students' characteristics, and learning environment, which may contribute to this deviation?

**Quantitative Analysis**

Quantitative analysis is carried out on responses to Yes/No and multiple choice questions, where the choices mainly correspond to a multiple-scale rating such as "strongly disagree, disagree, neutral, agree, strongly agree", or something similar. Questions are designed in three areas: features of Alice, students' characteristics, and the learning environment, following the conceptual framework above.

Cross-tabulations are done between each variable and the primary question to establish if there are any associations between them. Kramer's V (when the tables are larger than 2x2 in sizes) or Φ values (when the tables are 2x2 or smaller) are then calculated to measure the strength of the association. Kramer's V and Φ varies between 0 and 1, where values close to 0 show little association, and values close to 1 mean a strong association.

There may also be n-ary relationships among multiple variables. Results of the above tests are thus inspected to determine if there might be multi-dimension associations among the variables, and subject these groups of variable to muti-variate tests. Multi-variate tests are carried out for each of the variable that represents a significant difference between the two student cohorts (for instance, age, language, being an international student, etc.).

Results of these statistical tests and analyses are reported below.

Factors Related to Features of Alice

We find that the most significant factors that link to students' liking of Alice relate to the features of Alice rather than the learning environments or student's characteristics. Since the online students rate these features higher than on-campus students in most cases (see Tables B5 & B6 in Appendix B), it is obvious that these factors (features of Alice) contribute strongly to the deviation between the two student cohorts. Top of the list is the fact that students feel motivated that they can write programs graphically and can animate programs (Kramer's V = 0.535, indicating a pretty strong correlation). Other significant factors belonging to this category include graphics and animation help or motivate students' understanding (Kramer's V ranging from 0.450 to 0.477), the ability to program by dragging and dropping things (0.454) and other features and facilities in Alice that assist in learning various programming concepts (Kramer's V ranging from 0.362 to 0.454). The factor that scores lowest in this category is that Alice is not a commercial tool (0.303).

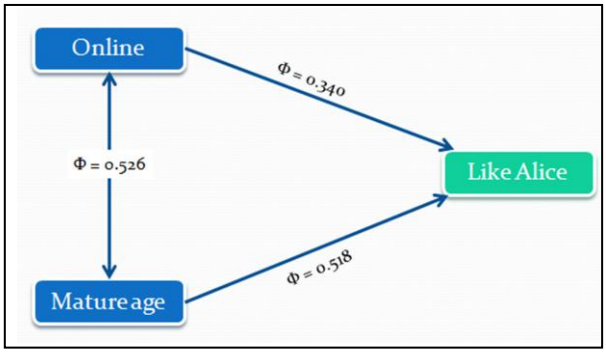


**Figure 2: Three-way relationship between study mode, age and the liking of Alice**.

Factors Related to Students' Characteristics

A student's characteristic that is strongly linked with student's liking of Alice is mature age (over 25 years old), with a Kramer's V value of 0.518 (moderately strong).

When analyzing the combined influence of study mode, age, and attitude towards Alice, we find a tri-variate relationship. Many online students are mature age (75.6% online versus 10% on-campus), and many mature age students say that they like learning programming with Alice

(62.8% mature age compared to 12% non-mature age).

As elements of learning environment do not seem to directly relate to the liking of Alice (see further analysis below), this suggests that the driving factor that affects students' attitude toward Alice in this tri-variate may be mature age rather than study mode (see Fig. 2).

A similar tri-variate is that among study mode, English as the first language, and the liking of Alice. Students whose English is the first language is more likely to like Alice (Φ = 0.315, a moderate association), and is quite likely to be an online student (Φ = 0.511, a moderately strong association). Similar to the above case, this tri-variate also suggests that language may be the driving factor in students' attitude toward Alice rather than study mode (see Fig. 3).

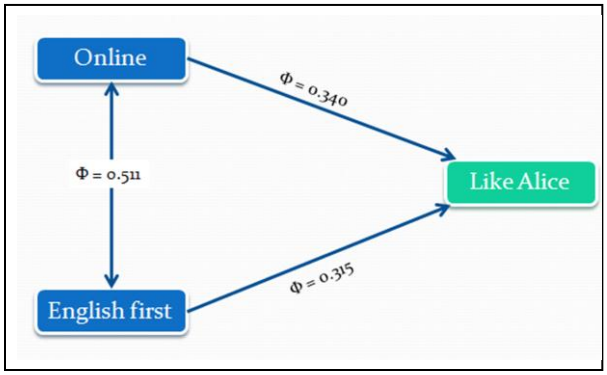


**Figure 3: Three-way relationship between study mode, English as the first language and the liking of Alice**.

Another note-worthy tri-variate is that among communication frequency, student being an independent learner and students' attitude towards Alice in the on-campus cohort. Regardless of the communication method used, we find that those who communicate less are more likely to say that they are independent learners and more likely to like Alice, especially when the method used is face-to-face, the exclusive and most used method among on-campus students (see Fig. B6 to B10 and Table B1 in Appendix B). This may suggest that non-independent learners, who communicate more with peers, may somehow be influenced more by peers for (negative) opinions about Alice. Fig. 4 depicts this three-way relationships for the face-to-face communication method. This interpretation however, must be taken with great reservation, because the association between independent learner and face-to-face communication method is very weak to negligible (Kramer's V = 0.228).

The above tri-variate is not true in the online group, where the most used communication method, Blackboard forum, is proportionately linked to the liking of Alice (Kramer's V = 0.30) but disproportionately linked to independent learners (Kramer's V = 0.328). We think that for online students, it is logical that those who actively participate in online discussion forum are more likely to be interested in and appreciate Alice and the link to independent learner is perhaps not significant. This interpretation however is not conclusive.

Other students' characteristics that may be associated with the liking of Alice are gender (0.295), good at drawing (0.288), visual learner (0.278), international students (0.251) and good at math (0.232). There seems to be no relationships between these variables and the study mode. Interestingly, prior programming experience does not change the liking of Alice. Also, contrary to the expectation that female students might like Alice more (because of its female name), and also students who are good at drawing, the relationships between these two variables and the liking of Alice is the other way round. However with the small sample size, especially for the on-campus students, we think these associations and anyone's with Kramer's V or Φ values under 0.3 (which signifies a weak relationship) may be considered negligible in this project.

Factors Related to Learning Environment

Elements pertaining to the learning environment do not appear to strongly influence students' attitude towards Alice. The most significant ones in this category are feeling unmotivated in learning environment (0.261), feeling isolated in learning environment (0.245), and independent learner (0.228). However as we consider that associations with Kramer's V or Φ values under 0.3 negligible, these associations are not significant. Interestingly, there appear to be no significant relationship between these variables and the study mode.

Below is the list of all factors that link to the liking of Alice, in order of likely strength. The links are positive in most cases (ie. higher rating

in the factor means higher liking of Alice), except where indicated otherwise:

- Students feel motivated that they can write programs graphically (Kramer's V = 0.535), and can animate programs (Kramer's V = 0.535)
- Students feel motivated that they can animate programs (0.535)
- Mature age (0.518)
- Graphics and animation helps understanding (0.477 , 0.470)
- Graphics and animation motivates learning (0.450, 0.471)
- Easy to learn control structures (0.454)
- Drag-drop (0.445)
- Helps grasp OO concepts (0.435)
- Improves problem-solving skills (0.433)
- Built-in methods / functions (0.406) and properties (0.382)
- Helps understand event-driven programming (0.383)
- Alice object library adequate (0.363)
- ArrayVisualisation facilitates understanding of arrays (0.362)
- Face-to-face communication (0.359, negative)
- Blackboard forum communication (0.30)
- Easy to learn to write own methods / functions (0.324)
- Independent learner (0.316)
- English is the first language (0.315)
- Alice is not a commercial tool (0.303)
- Gender (0.295, male is more likely to like Alice)
- Good at drawing (0.288, negative link)
- Visual learner (0.278)
- Feeling unmotivated in learning environment (0.261)
- International students (0.251)
- Feeling isolated in learning environment (0.245)
- Good at Maths (0.232)

**Qualitative Analysis**

The open-ended questions, which are optional in the survey, provide the basis for our qualitative analysis. 41 out of 45 online students (93%) and 6 out of 10 on-campus students (60%) answered all or some of the open-end questions. We performed a small scale qualitative analysis with these responses to the open ended questions. Data was processed using grounded theoretic approach (Strauss & Corbin, 1998) i.e. open, axial and selective coding (Neuman, 2006; Strauss & Corbin, 1990) so that information relevant to the research could be extracted. Nvivo 8 software was used to investigate data through open, axial and selective coding.

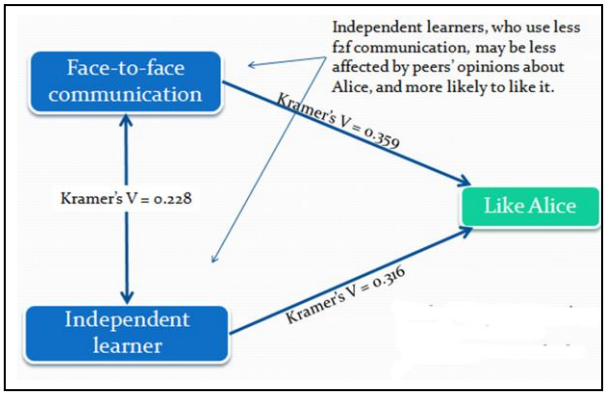


**Figure 4: Three-way relationship between f2f communication, being an independent learner and the liking of Alice.**

We attempted to uncover all the themes by analyzing the survey responses. These themes provided a clear representation regarding why the students like or dislike Alice as an introductory programming language and whether it should be continued to be used as a learning tool for fully online or on-campus students. As mentioned above, the sample size for the on-campus population is quite small; hence, the interpretation of the qualitative analysis suggested here should be taken with reservation.

The purpose of open coding was to identify the reasons behind the students' being satisfied or dissatisfied with Alice and the future of Alice as an introductory programming language. Each separate concept in the data was labeled and similar ideas were grouped and labeled. Following open coding, the next step was axial coding, where the aim was to assemble coding categories into larger conceptual groupings (Glaser & Strauss, 1967). The three major categories were: 1. Why students are satisfied with Alice; 2. Why students are not satisfied with Alice; and 3. Why should or should not Alice be continued to use as an introductory programming learning tool.

The third and final coding step was selective coding. Again, the data were re-examined and the prior coding and grouping was revisited and verified or changed as required.

An overview of the results of data analysis is presented in the table 1.

Why are students satisfied with Alice as an introductory programming language

From Table 1, we can observe that students are mainly attracted to Alice because of its graphical interface The animated graphical features makes leaning easier, faster and more motivating as students can visualize the effects of the programming code.

Ease of use is another major factor that contributes to students' liking of Alice; most notably the drag and drop features, built-in methods, functions and object library, and also graphical visualisation.

Students acknowledged that Alice helped them learn some programming concepts rather easily, specially loops and conditional statements, and some object-oriented programming concepts such as how to design or build classes and methods.

They also appreciated the fact that they could see the effects of their code instantly, and could track errors fairly easily. These findings generally correspond with the quantitative analysis above.

*I found Alice a great teaching tool as it was a good way to implement the concepts and to be able to see what was happening. <Survey-online student>*

*[I like Alice in] That it is easy to use Graphical interface is great Syntax comes pre-written, logic is the only thing missing. <Survey-on-campus student>*

Why are students not satisfied with Alice as an introductory programming language

The most cited reasons for students' dislike of Alice are bugs and the program limitations. Frequent crashes, inconsistent behaviour or messages were those that frustrate students the most. Limitations are mainly caused by the very simplicity and ease of use that they or other students liked. For instance, students feel limited by the drag and drop feature because they cannot write their own code, and also they cannot learn "proper" program writing.

| Analysis Criteria | Number of Online Students Mentioned about the Criteria | Number of On-campus Students Mentioned about the Criteria |
|---|---|---|
| Why are Students Satisfied with Alice as an Introductory Programming Language | | |
| Graphical Visualisation | 17 out of 41 | 4 out of 6 |
| Ease of Use | 16 out of 41 | 4 out of 6 |
| Concepts Seemed Easy Because of Alice | 14 out of 41 | 0 out of 6 |
| Instant Feedback | 9 out of 41 | 0 out of 6 |
| Why are Students not Satisfied with Alice as an Introductory Programming Language | | |
| Bugs in the Language | 18 out of 41 | 1 out of 6 |
| Program limitations | 12 out of 41 | 3 out of 6 |
| Non Commercial Language | 6 out of 41 | 2 out of 6 |
| Concepts Difficult because of Online Environment | 5 out of 41 | 0 out of 6 |
| Difficulty in Dealing with errors | 4 out of 41 | 0 out of 6 |
| Installation Issues | 2 out of 41 | 0 out of 6 |
| Student's Perceptions about the Future of Alice as a Teaching Tool for Introductory Programming Courses | | |
| Start with Alice and then Java | 12 out of 41 | 0 out of 6 |
| Java, no Alice | 10 out of 41 | 6 out of 6 |
| Any other Commercial Programming Language | 10 out of 41 | 1 out of 6 |
| Start with both Alice and Java Together | 4 out of 41 | 0 out of 6 |
| Start with Alice and then Smooth and Quick Transition to Java | 4 out of 41 | 0 out of 6 |
| Alice, no Java | 2 out of 41 | 0 out of 6 |

**Table 1: Students' perception about Alice.**

Another noticeable concern is that Alice is not a commercial language and students feel using it to teach programming will not help them in future. Problems with installation and tracking errors are also mentioned a few times.

Some online students do think that perhaps not Alice but the fully online environment may be the reason why they cannot grasp some programming concepts easily. This number however, is very small (5/41 or 12%). Another small number of students (2/41) acknowledge that their (negative) judgment on Alice may be biased because they have done some programming before.

*Alice is really buggy and unreliable. <Survey – online student>*

*[I don't like] Most of it, it's incredibly cheesy and if you try to replicate more complex functions (from a Java program) they're harder to understand.. <Survey – on-campus student>*

Student's perceptions about the future use of Alice to teach introductory programming

The majority of online students who responded to the open-ended questions prefer some combination of Alice and Java in their course.

Just over one-third of these (8/20) suggest a stronger emphasis on Java in some way. Only very few (2/41) say that they want Alice only. About 25% (10/41) of the students do not want Alice at all, and another 25% like to use some other commercial programming languages. The reason cited most often among these 2 groups is that they prefer a "real" programming language to a teaching-only one like Alice. Note that responses may overlap because some students who like both Alice and Java may also say that they like other commercial programming languages to be used.

All the on-campus students are against the idea of using Alice to teach introductory programming. Most prefer to use either Java or another commercial programming language such as C, C++, Visual Basic, etc, which can provide them with hands-on experience working in a more "real-world" situation.

*I prefer Java, Visual Basic, SAP its help with job prospect. <Survey – online student>*

*Java, it is more related to what we might do in the future and in the work environment. <Survey – on-campus student>*

The qualitative analysis confirms the two main findings of the quantitative analysis. These are: (i) online students are more positive about Alice than on-campus students, and (ii) the learning environment does not appear to influence students' attitude towards Alice. It also confirms the finding that students are mostly attracted to Alice because of its graphical capabilities and ease of use, which enable students to grasp programming concepts more readily. It can neither confirm nor reject the tri-variate relationships, but it does reveal some more details in other areas. Most notably, it shows that students do not like Alice mainly because it is buggy and it is a non-commercial language.

## 4. CONCLUSIONS

The findings confirm the alternative hypothesis ($p=0.013$). It is more likely that online students like Alice than on-campus students (a moderate association with $\Phi = 0.34$). This deviation however, is not likely to be influenced by the learning environment or study mode per se, but perhaps by age, communication frequency, and English as the first language. Mature age may help students appreciate Alice more. In the on-campus cohort, there is a possibility that students who communicate more (thus are less independent learners), especially in the face-to-face fashion that is exclusively used by on-campus students, may be more influenced by their peer (negative) opinions about Alice, although this interpretation must be taken with great reservation. We cannot explain why English as first language may be linked to the liking of Alice, but this is only a lowly moderate link. The findings also confirm that Alice is most appreciated (33 out of 41 students) for its graphics, visualisation and animation capabilities, and ease of use, which enables students to learn difficult programming concepts more easily, but most disliked (30 out of 41 students) for its bugginess and limitations.

These findings suggest that if we keep Alice, we should try to use it for mature age students and independent learners, and design our course materials to make the best use of the above features of Alice that are most appreciated by students. However the retention of Alice in the curriculum is questionable. Even among the population in which Alice is more favorable (the

online students), the percentage of students who do not say that they like Alice and are not convinced of the benefit of Alice are still high (46.5% and 43.8% respectively). Cliburn (2008) did have to remove Alice from the curriculum in a similar situation. We think unless we can deploy Alice for an "ideal" group of students (i.e. mature age and independent learners according to this study), its benefits are likely outweighed by its disadvantages.

As the sample size of the on-campus group is quite small however, the conclusion above should be taken with reservation. We are currently extending the project to survey more students and hope to be able to reach a more definite conclusion about this.

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**APPENDIX A**

**Survey questions**

1. Are you studying this course fully online? **Yes / No/ Not applicable**

2. Is this the first time you do an online course (choose not applicable if you are not an online student)? **Yes / No / Not applicable**

3. Is your first language English? **Yes / No / Not applicable**

4. Are you an international student? **Yes / No / Not applicable**

5. What is your gender? **Female / Male / Not specified**

6. Are you a mature age student (over 25)? **Yes / No / Not applicable**

7. Are you an undergraduate student? **Yes / No / Not applicable**

8. Have you had any programming experience in any programming or scripting language prior to this course? **Yes / No / Not applicable**

9. What methods do you use to interact with other fellow students in this course? Please rate the following methods:

| Methods of interaction | 5-6 times a week or more | 3-4 times a week | 1-2 times a week | Less than once a week | Never used |
|---|---|---|---|---|---|
| Face-to-face | | | | | |
| Email | | | | | |
| Phone | | | | | |
| Blackboard Discussion forum | | | | | |
| Blackboard or Elluminate chat | | | | | |
| Blackboard wiki or blog | | | | | |
| Phone | | | | | |
| Other online communication methods | | | | | |

**10.** Alice is a teaching tool and not a commercial tool (like Java) for programming. In what way, if any, does this influence your motivation to learn Alice? (Please choose one) **More Motivated / Neutral / Less motivated / I am not aware of that / Other (please specify)**

11. How did you grade your attitude towards COMPUTERS PRIOR to this course? Please rate your attitude for each statement below:

| Attitude | Strong Disagree | Disagree | Neutral | Agree | Strongly Agree |
|---|---|---|---|---|---|
| I feel anxious about using computers | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| I feel confident about using computers | | | | | |
| I like using computers | | | | | |
| I find computers useful | | | | | |
| I enjoy computers because they help me be creative | | | | | |

12. How did you grade your attitude towards COMPUTERS NOW that you have participated in this course? Please rate your attitude for each statement below: (same attitudes and ratings as question 11)

13. How did you grade your attitude towards PROGRAMMING PRIOR to this course? Please rate your attitude for each statement below: (same attitudes and ratings as question 11)

14. How did you grade your attitude towards PROGRAMMING NOW that you have participated in this course? Please rate your attitude for each statement below: (same attitudes and ratings as question 11)

15. Please answer the following questions by indicating the number that most closely corresponds with your judgments for each of the criteria statements below.

| Criteria Statements | Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree |
|---|---|---|---|---|---|
| 1. I am good with Mathematics | | | | | |
| 2. I am good at drawing | | | | | |
| 3. I am a visual learner – visualization helps me learn better | | | | | |
| 4. I am an independent learner and do not interact much with peers | | | | | |
| 5. I feel isolated in my learning environment | | | | | |
| 6. I feel unmotivated in my learning environment | | | | | |
| 7. I feel motivated to learn programming with Alice | | | | | |
| 8. I feel motivated that I can write programs graphically in Alice | | | | | |
| 9. I feel motivated that I can animate programs in Alice | | | | | |
| 10. In general graphics helps me understand programming concepts better | | | | | |
| 11. In general animation helps me understand programming concepts better | | | | | |
| 12. In general graphics motivates me to learn programming | | | | | |
| 13. In general animation motivates me to learn programming | | | | | |
| 14. I feel that Alice helps me grasp object-oriented concepts more easily than other non-graphical object-oriented languages | | | | | |
| 15. I think the library of objects in Alice is adequate for my course | | | | | |
| 16. I think the built-in methods provided for objects in Alice are adequate for my course | | | | | |
| 17. I think the built-in properties provided for | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| objects in Alice are adequate for my course | | | | | |
| 18. I think my problem-solving skills have been improved with the storyboarding technique used in Alice | | | | | |
| 19. I can learn about control structures (IF/ELSE, LOOP, etc) in Alice easily | | | | | |
| 20. The ArrayVisualisation facility in Alice helps me learn about arrays | | | | | |
| 21. I can understand event-driven programming easily in Alice | | | | | |
| 22. I can learn about how to write my own methods/functions easily with Alice | | | | | |
| 23. I like the “drag-and-drop” way of writing programs in Alice | | | | | |
| 24. I think it is good to use Alice to teach beginners programming FIRST before transitioning into Java | | | | | |
| 25. I think it is good to use Alice SIMULTANEOUSLY with Java to teach programming to beginners | | | | | |
| 26. I think it is necessary to use Alice to teach programming to beginners | | | | | |
| 27. In general I like learning programming with Alice | | | | | |
| 28. I will recommend this course to anyone who wants to learn introductory programming | | | | | |

16. What aspects of Alice do you like? Why?

17. What aspects of Alice do you dislike? Why?

18. Can you name a specific concept that you found DIFFICULT in this course? Do you think you found it difficult because of the use of Alice? And/Or because of the mode of study of this course (online or on-campus)? Why/why not?

19. Can you name a specific concept that you found EASY in this course? Do you think you found it easy because of the use of Alice? And/Or because of the mode of study of this course (online or on-campus)? Why/why not?

20. If you could choose, which programming language do you prefer to be used in this course? Why?

21. Do you have any suggestions regarding the use of Alice in this course?

## APPENDIX B

### Graphs and Tables

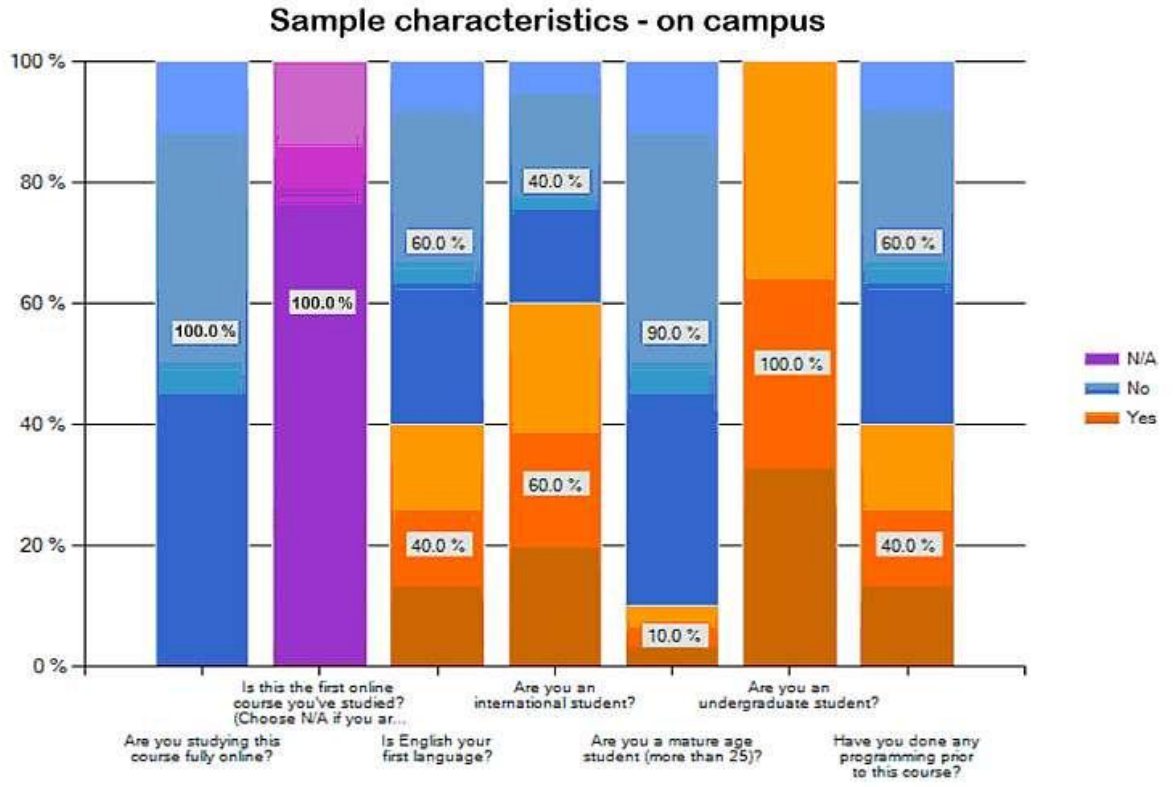


Figure B1. Students' characteristics – on-campus

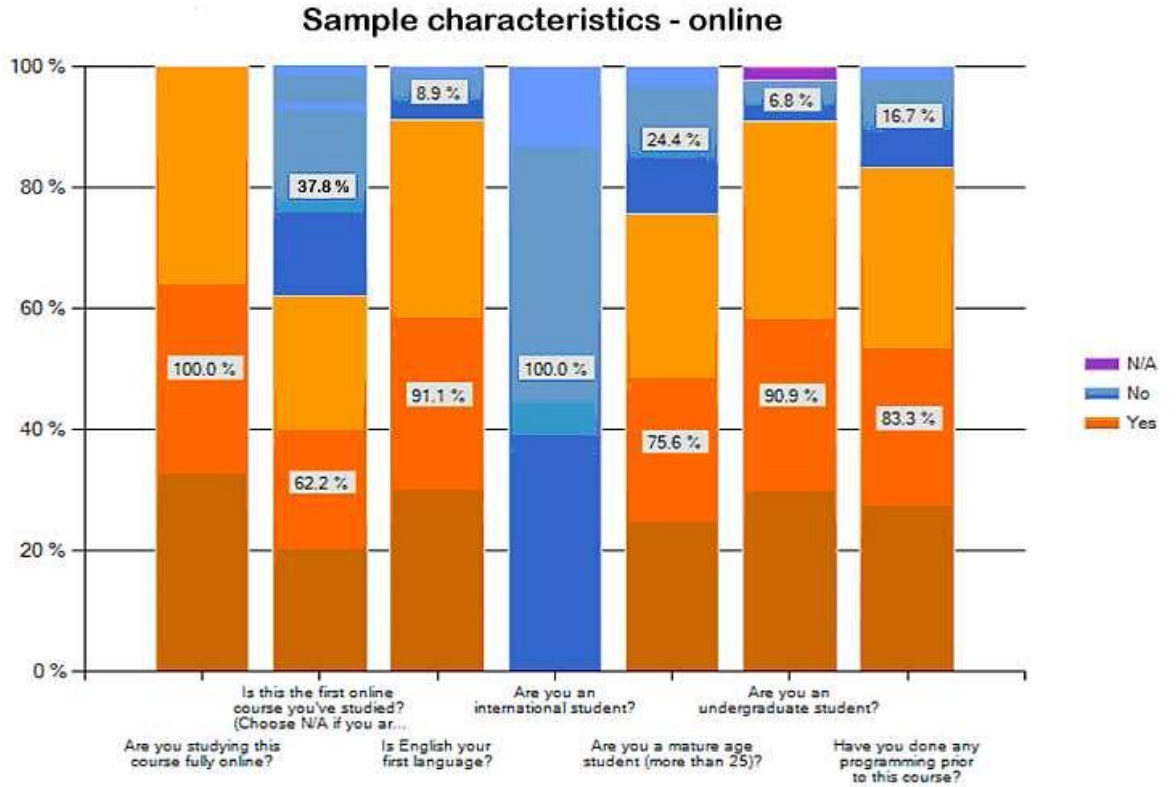

Figure B2 – Student characteristics – online

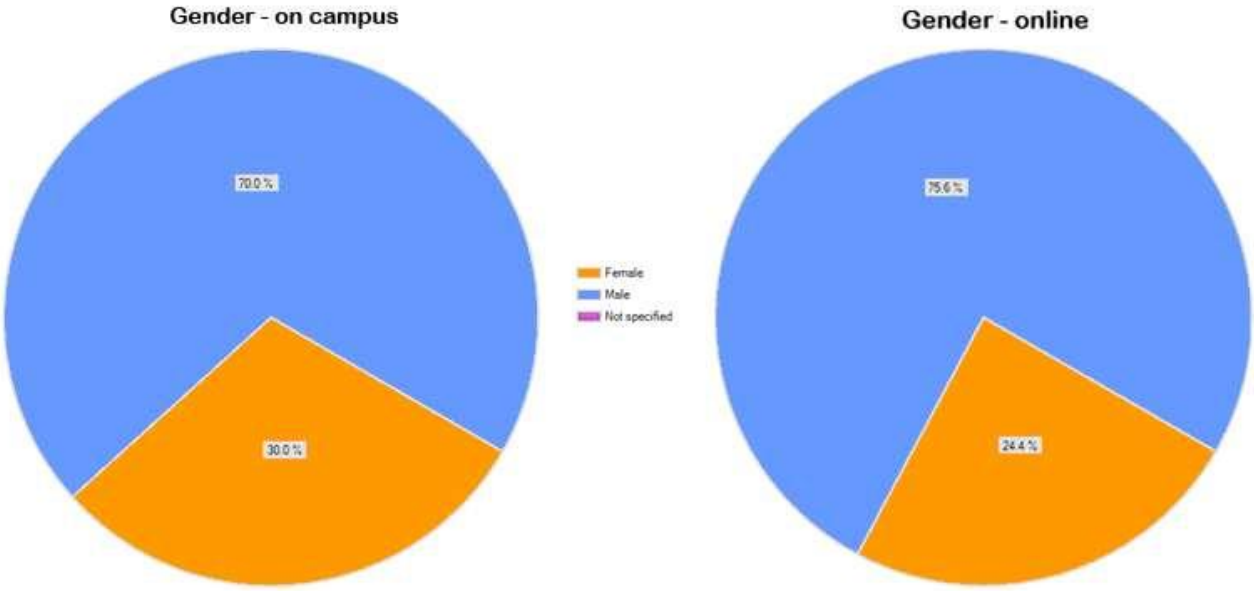


Figure B3 – Student gender

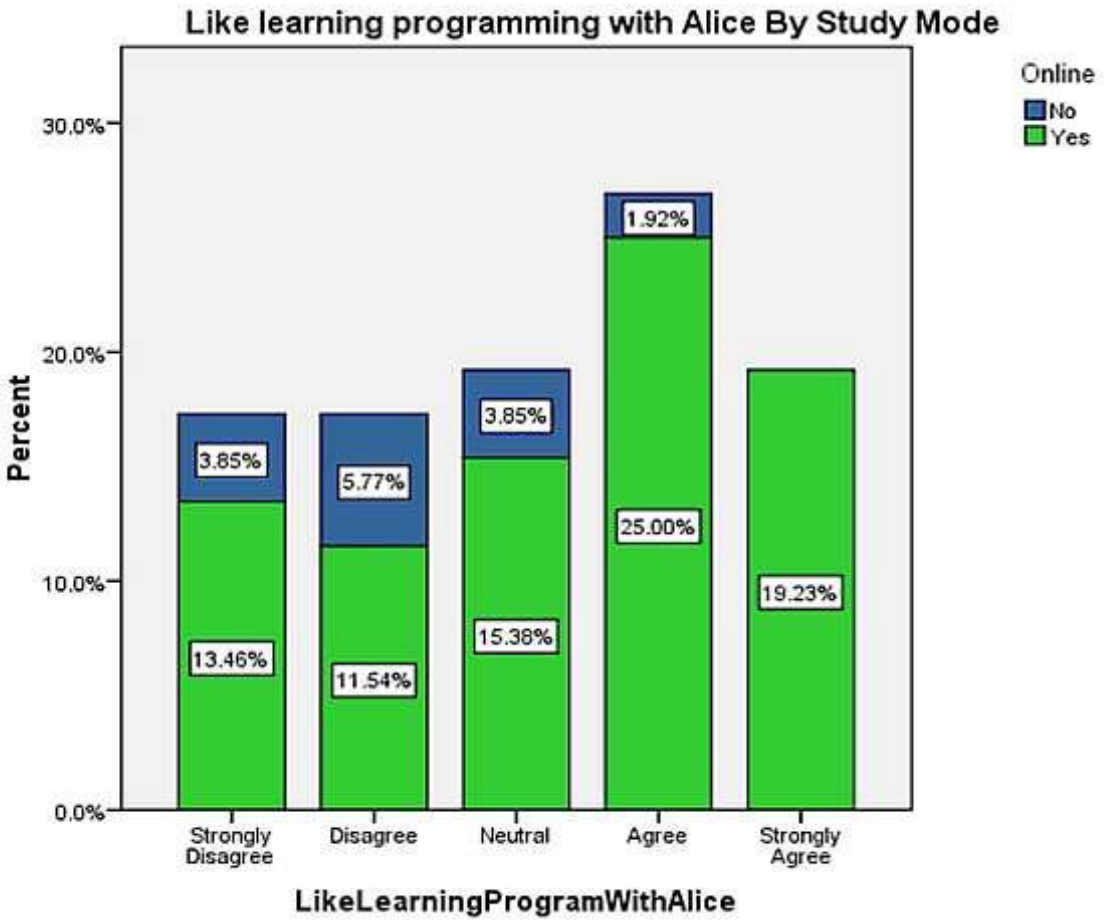


Figure B4 – Like Alice By Study Mode

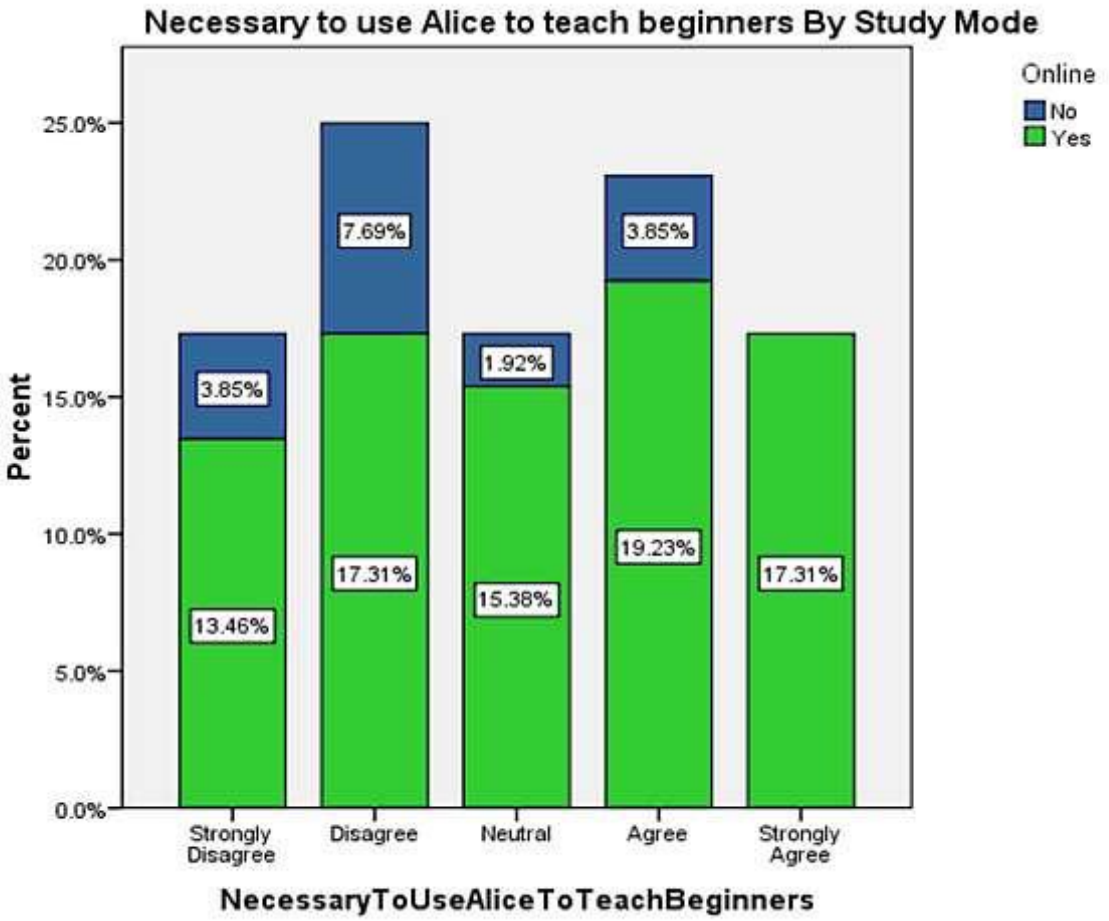


Figure B5 – Necessary to use Alice for beginners By Study Mode

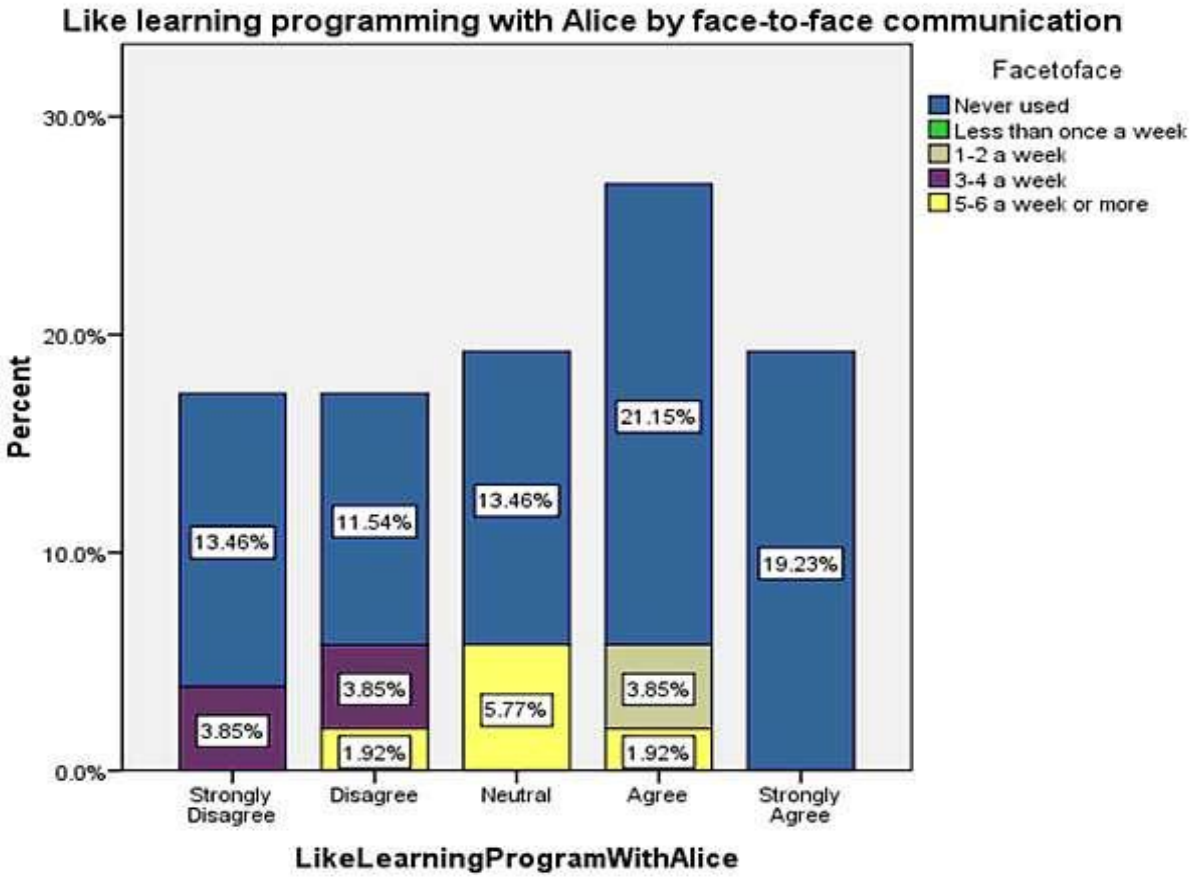


Figure B6 – Like Alice By Face-to-Face Communication

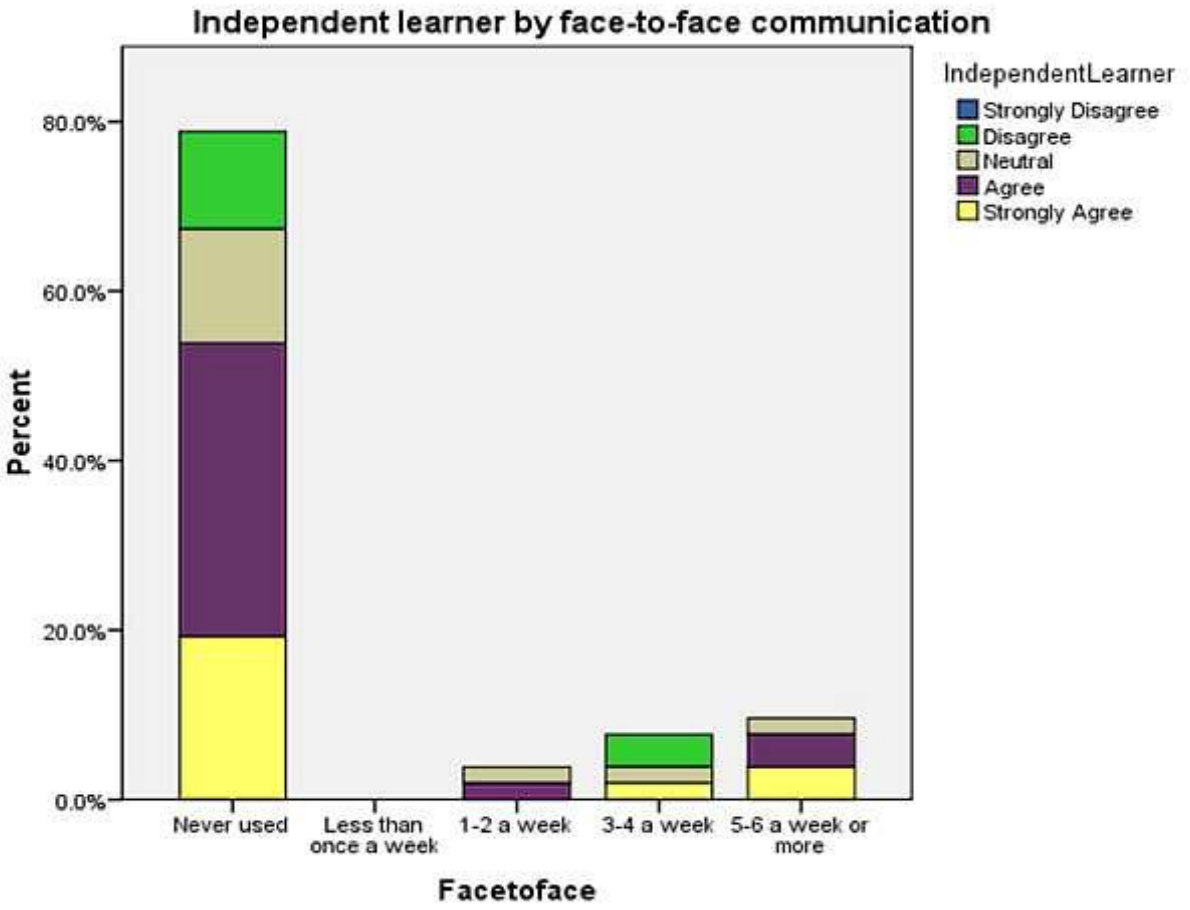


Figure B7 – Independent Learners By Face-to-Face Communication

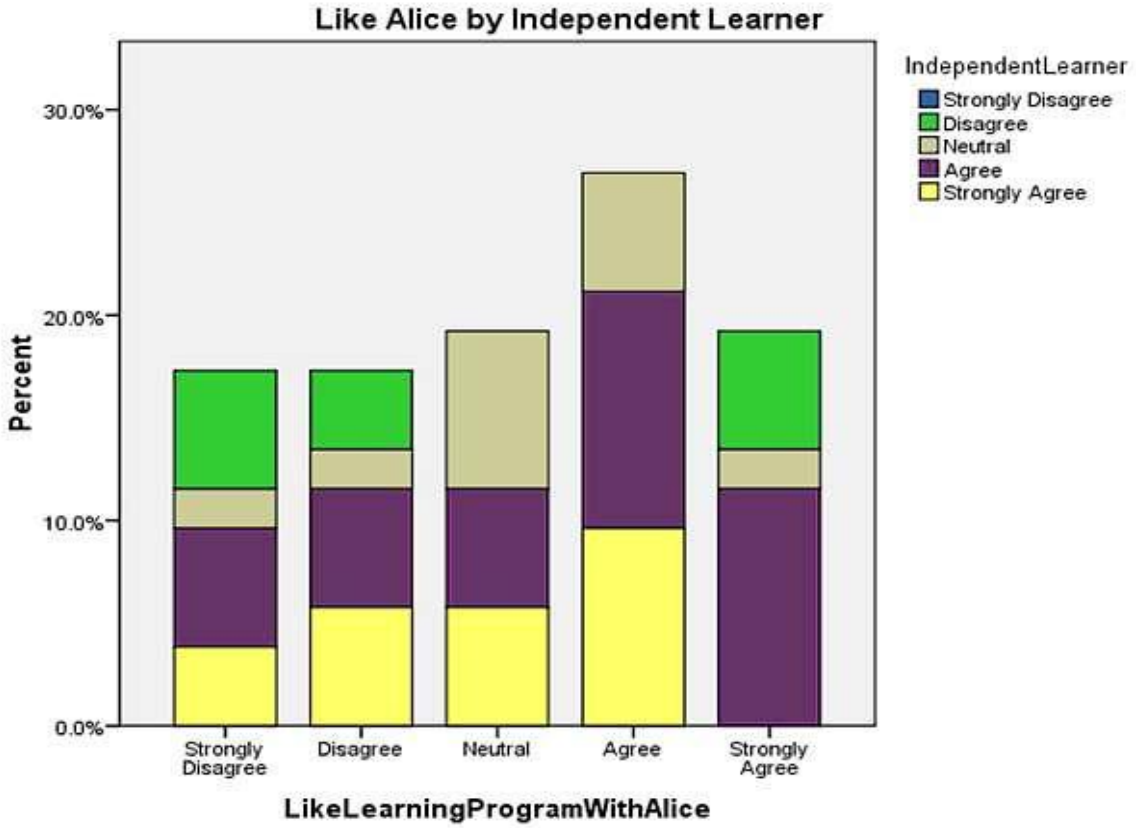

Figure B8 – Like Alice By Independent Learner

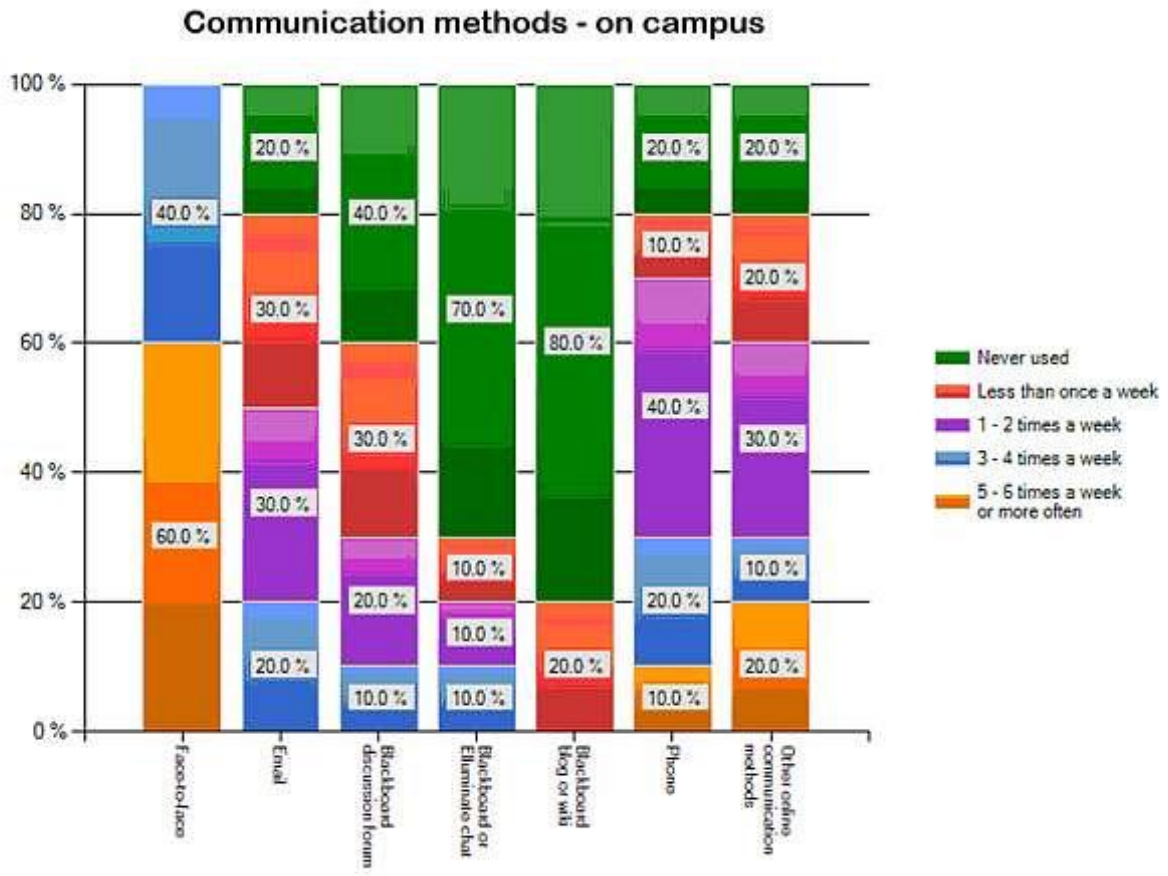


Fig. B9 – Communication methods – on campus

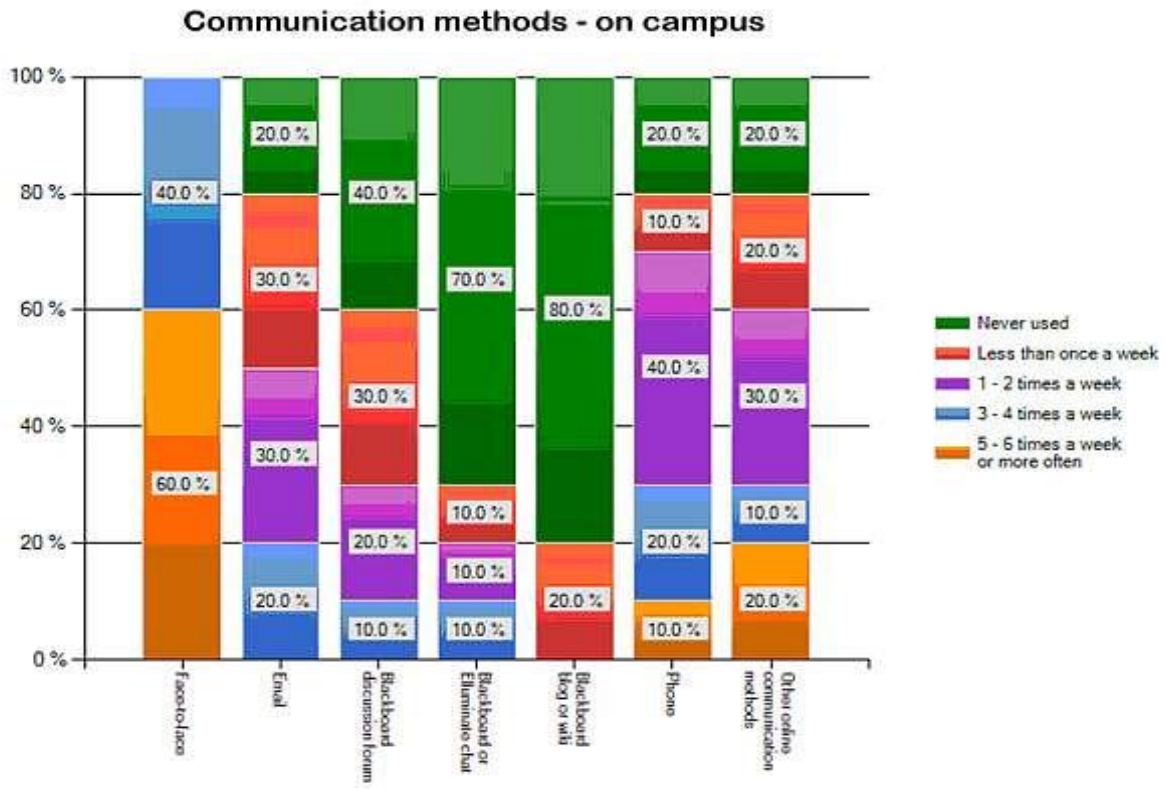


Fig B10 – Communication methods – online

| | Face-to-face | Email | BB Forum | BB or Elluminate Chat | BB Blog Or Wiki | Phone | Other Online Methods |
|---|---|---|---|---|---|---|---|
| online | 0.00 | 0.54 | 2.42 | 1.21 | 0.50 | 0.17 | 0.63 |
| on campus | 3.60 | 1.50 | 1.00 | 0.60 | 0.20 | 1.90 | 1.90 |

Table B1 – Average Ratings of Communication methods

| | Alice Not Commercial Tool Influence |
|---|---|
| online | 2.46 |
| on campus | 1.80 |

Table B2 – Average Ratings of Influence of Alice Being Not A Commercial Tool

| | Good At Maths | Good At Drawing | Visual Learner | Independent Learner |
|---|---|---|---|---|
| online | 2.79 | 1.83 | 2.79 | 2.67 |
| on campus | 2.44 | 2.67 | 2.89 | 2.67 |

Table B3 – Average Ratings of Learner's Characteristics

| | Feel Isolated In Learning Environment | Feel Unmotivated In Learning Environment |
|---|---|---|
| online | 1.75 | 1.13 |
| on campus | 1.67 | 1.56 |

Table B4 – Average Ratings of Feelings about the Learning Environment

| | Alice Helps Grasp OO Concepts | Alice Object Library Adequate | Alice Built-in Methods/Functions Adequate | Alice Built-in Properties Adequate | Problem Solving Skills Improved With Alice Story Boarding |
|---|---|---|---|---|---|
| online | 2.33 | 2.92 | 2.67 | 2.83 | 2.42 |
| on campus | 2.33 | 2.33 | 2.33 | 2.00 | 1.67 |

Table B5 – Average Ratings of Alice Features 1

| | Easy To Learn Control Structures In Alice | Array Visualisation Facility Helps Learn Array | Event Driven Programming Easy To Understand In Alice | Learn Writing Own Methods / Functions Easy In Alice | Like Alice Drag Drop |
|---|---|---|---|---|---|
| online | 2.75 | 2.25 | 2.79 | 2.67 | 2.21 |
| on campus | 2.11 | 1.67 | 2.22 | 2.44 | 2.22 |

Table B6 – Average Ratings of Alice Features 2

| | Good To Use Alice FIRST Before Java | Good To Use Alice SIMULTANEOUSLY With Java |
|---|---|---|
| online | 2.75 | 2.17 |
| on campus | 2.78 | 2.11 |

Table B7- Average Ratings of Students' Opinion About Timing of Alice & Java

| | Necessary To Use Alice To Teach Beginners | Like Learning Program With Alice | Recommend This Course |
|---|---|---|---|
| online | 2.17 | 2.08 | 3.04 |
| on campus | 1.33 | 1.33 | 3.11 |

Table B8 – Average Ratings of Students' Attitude about Alice and This Course