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COMPUTER SCIENCE

Overall grade boundaries

Grade:	E	D	C	B	A
Mark range:	0 - 7	8 - 15	16 - 22	23 - 28	29 - 36

The range and suitability of the work submitted

This was the first session under the revised guidelines which are now common across all subjects. This report will examine the effects of these changes with respect to the essays submitted under the subject computer science.

An extended essay provides an opportunity for a student to research a topic independently to a level of understanding deeper than he/she previously had, to analyze the results of this research providing appropriate conclusions, and to produce a written report that presents the research in a clear and understandable way.

A computer science essay is one that explores the reasons for how or why an element or application of IT actually functions. It must go beyond the level of popular journalism and deeper than the knowledge expected of an IB computer science student. An essay that is basically descriptive will fail to gain as much credit as one that seeks to investigate and explain.

The vast majority of essays chose topics that could have produced good computer science essays. There were few that clearly fell into other areas of the IB curriculum.

Students that chose topics that allowed them to research deeply into the relevant computer science were the ones that scored high marks.

Some students used the extended essay as an opportunity to voice their own feelings about a particular issue (e.g. *negative publicity given to hackers*). Such essays almost always gained low marks.

More detail on the suitability of the chosen area of study is given below under the 'research question' heading.

Candidate performance against each criterion

A: research question

The suitable selection of the research question remains the key to a successful essay. Too general a topic will make any realistic attempt to produce anything more than a superficial investigation impossible.

A topic which has an obvious answer will likewise limit any meaningful investigation and will fail to engage the reader's interest.

On the other hand a question that is sharply focused will force the author to go deeper into the subject than both his/her own previous knowledge and possibly that of the reader. Although the extended essay is not intended to be anywhere near the level of a thesis, the basic principals remain the same, the main one being that the reader hopes to gain further insight into a topic than he/she previously had.

Although the research question does not have to be phased as a question, it is recommended that it is, as it helps to force the student (at the high school level) to include the basics elements of a research essay: the original question, the research that attempts to answer the question and the conclusions which reflect the results of the research.

Finally to avoid loss of marks the focus of the essay must be clearly within the field of computer science. Those that involve IT but are principally focused in another subject will fail to gain high marks.

B: introduction

Although many students would have included an introduction under the previous criteria, this is the first time that this section has explicitly received marks. Virtually all students included an introduction this session, but a large number failed to correctly address the requirements laid out in the criterion. Students must provide sufficient background information to set the essay's topic firmly in context, **and** clearly show the importance of the research question.

Consider, for example, the following research question:

How has biometrics enhanced the security of laptops?

To set the research question in context, the introduction would have made detailed reference both to the development of biometrics and the increasing popularity of laptop computers. The importance of the question could have been shown by making reference to the diverse range of people who use laptops (including those who might use them to store classified documents) and the ease which laptops can be stolen or lost.

It was clear that many students simply provided the same general introduction as in previous years, without specifically checking that the two points previously mentioned had been correctly addressed. This is one of the criteria in which full marks can easily be gained irrespective of the quality of the research.

C: investigation

This criterion measures both how well the research has been planned and the quality of the sources utilized.

An essay that has been carefully planned will show a sequence that follows logically from the structure indicated in the introduction through the research in the main body of the essay to the resulting analysis and conclusions. This is where the role of the supervisor is of paramount importance. The student should not be given the green light to proceed until the research has been satisfactorily planned. This does not, of course, include the outcome of the research. If this is already known, the essay is unlikely to be of a high quality.

The sources should be both varied and reliable. A common error in this session was to rely too heavily on a single source such as *wikipedia.com*. Although *Wikipedia* has become an invaluable source of information, it cannot become the only source for a serious research essay. Another error was to list a whole range of sources in the bibliography, even though only a few had actually been referenced.

D: knowledge and understanding of the topic studied

The degree to which an essay has actually involved itself in computer science is shown quite clearly by this criterion. An essay that is basically descriptive, is not focused or only tangentially involves computer science, will not allow the student to demonstrate his/her understanding of the relevant field of computer science. Nor is it enough to produce a series of quotes or paraphrases from sources. The student needs to show through his/her own personal explanations or summaries that he/she clearly understands the basic concepts of the topic researched.

E: reasoned argument

This criterion, together with the following, measures to a large extent the quality of both the research and the essay itself. An essay that is well reasoned will have the reader agreeing with the analysis / evaluation as the essay progresses. One that makes unjustified statements will have the opposite effect.

The essay should stay within the bounds of the originally stated intentions and not wander off at tangents.

F: application of analytical and evaluative skills appropriate to the subject

The application of this criterion (together with the previous) is fundamental to the success, or otherwise, of the essay. A essay which is largely descriptive, and there were many such essays, will fail to provide any meaningful analysis.

Many of the less successful essays simply followed the sequence of one or two sources, and basically précised the texts. This may show evidence of the research skills of the author but would normally not provide, on its own, any evidence of his/her analytical skills. Students need to stop from time to time, consider what they have written and provide analysis or evaluation *in their own words*.

Essays that were experimental, which is common with computer science, will provide opportunities for analysis. Many students highlighted their results using graphs, but the graphs alone are not sufficient if they not accompanied by suitable analysis. A typical error would be just to restate what it clearly obvious from the graphs without explaining the underlying reasons for those results.

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G: use of language appropriate to the subject

Two related factors contribute to the marking of this criterion: how well the essay is written, and the extent to the language of the subject (in this case computer science) is used. The essay must be understandable and easy to read. Students would do well to study some of the popular scientific and technical journals and magazines to see the extent that the authors go to in order to clarify technical terms and concepts. Diagrams play an important part in providing this clarity. There were many occasions this session when the inclusion of a simple diagram would have both improved the readability of the essay and the understanding of the ideas presented.

Another common mistake was to simply take technical terms from the sources without further explanations. Top marks can only be gained in this criterion if it is clear that the student understands the terminology being used.

H: conclusion

Not enough thought is given by many students to what is an essential part of any research essay at any level. Too many see this as no more than a final section that finishes off the essay. Again, the value of stating the purpose of the research as an actual question can be seen here, as the conclusion then answers the original question.

Any conclusions must be convincing. They must clearly be a product or a consequence of the preceding research. Many conclusions are, however, a product of "wishful thinking" on the part of the student, ones which they think the essay should have rather than ones that have shown to be valid. Not all research will provide clear conclusions. In these cases, it is perfectly acceptable to acknowledge this, whilst providing reasons and explanations.

An implication of the word limit of 4000 words is that even a focused topic can only be explored so far. The conclusion provides an opportunity to suggest how the research could be continued, or to highlight new questions that may have arisen.

I: formal presentation

The presentation of most of the essays was good. Most students used a consistent method of referencing although some did experience problems in providing a consistent format for the bibliography, especially when their references included both websites and publications. Bibliographies should be in alphabetical order for easy referencing (unless numbered citations are used) and major sections within the essay should normally start on a separate page.

The occasional essay failed to include either any references or a bibliography. These are such an essential part of any research essay that the omission of either would result in zero marks for this criterion.

J: abstract

The purpose of an abstract is to allow a prospective reader the opportunity to quickly ascertain the focus of the research provided by the essay. To this extent, the actual research question, the methodology used to carry out the research and the resulting conclusions are

fundamental elements of an abstract. It is disappointing how many students failed to address the requirements and produced instead a short overview of the topic.

It is recommended that the majority of the 300 words allowed for the abstract are actually used. Some abstracts were extremely brief, and whilst they may have included the three elements stated above, they would not have provided the reader with enough understanding of what awaits them, which as has already been stated, is the reason for the abstract's inclusion.

K: holistic judgment

Essays that gained the full four marks were ones where the student showed great initiative in successfully taking on a challenging topic.

Recommendations for the supervision of future candidates

The research question

- phrase it as a question
- make sure that it is focused
- make sure that it is not just an IT topic, but allows the student to explore the computer science aspects of the chosen area
- make sure that it is an area that the student is able to research
- don't let the student start until the RQ is agreed upon and acceptable

The investigation

- encourage the student to explore a variety of sources (text books as well as web-sites)
- encourage the student to question the reliability of all sources

The writing

- make sure that the student is absolutely clear on the requirements of each criterion
- encourage the student to not only use computer science terms but to also explain them when necessary
- encourage the student to provide his/her own analysis/evaluation where appropriate
- emphasize the importance of detailed analysis of any data produced (further than only displaying graphs)
- emphasize the importance of detailed, thoughtful and justified conclusions

Further comments

Not all teachers provide comments at the front of the extended essay. These comments can be very useful in highlighting any problems encountered or any particular qualities displayed by the student.