

Design Technology Extended Essay Subject Guide

Overview

An extended essay (EE) in design technology gives students an opportunity to undertake in-depth research into:

- the processes involved in the design and development of products or systems
- the impact of the products or systems' design on individuals and society.

The outcome of the research should be a coherent and structured piece of writing that effectively addresses a particular research question and arrives at a specific, and preferably personal, conclusion.

Students are expected to use a range of methods for the collection of data and the essay should use both primary and secondary sources. Absolute reliance on textbooks and the Internet is discouraged: no EE in design technology should be based exclusively on such sources.

Choice of topic

The topic must be concerned with issues relating directly to design technology. Where the topic may be approached from different viewpoints, students must examine it from a design technology perspective. Students are expected to be familiar with the design cycle, as set out in the Design technology guide.

Students are encouraged to select a topic that is appropriate to their interests and abilities and the resources available.

Essays may focus on systems design rather than a specific product, such as:

- investigating the benefits resulting from the introduction of end-of-pipe technology to reduce waste from the processing of iron ore
- investigating a cold chain for the distribution of heat-sensitive vaccines and antibiotics in a tropical climate

- evaluating the effectiveness of an automated manufacturing system for the mass customization of a particular product.

When choosing a topic, students should start by exploring appropriate design contexts. For example, it may be worth considering:

- artifacts that do not function effectively or seem wasteful of resources
- the needs of particular user groups such as the elderly, disabled or special needs;
- new technologies and how they might influence or converge with existing technologies.

Inappropriate topics

- A topic of a purely historical nature that merely documents the development of a product or technology.
- A topic that overlaps with the design project and uses the same literature, experiments, models or resources.
- A topic that merely reviews a technological product or technological development.

Examples of topics

These examples are just for guidance. Students must ensure their choice of topic is focused (left-hand column) rather than broad (right-hand column).

✓ Focused topics	× Broad topics
Investigating the limitations affecting maximum braking on a free-ride bicycle	Braking on a free-ride bicycle
Ergonomic design of kettles for use by those with arthritic wrist joints	Appliances for sufferers of arthritis
The impact on waste of dematerialization in food packaging	Waste dematerialization
Investigating intellectual property rights in an open-source world for product design	Open-source product design

Treatment of the topic

Students are expected to use a range of methods for the collection of data and the essay should use both primary and secondary sources. However, practical experimental work is not mandatory.

Use of primary sources

To promote their personal involvement, students should be encouraged to use locally available primary sources wherever possible. They can collect data from different sources using a variety of methods, and then analyze it using scientific and technological techniques.

However, they should only include in their essay data that is directly relevant to the chosen topic.

The inclusion of relevant graphical material will also significantly enhance the essay.

Practical and experimental work

As design technology is an experimental science, many students will wish to base their essay on practical or experimental work. However, this is not compulsory.

Practical activity may take the form of:

- experiments to test products or materials or evaluate performance
- modeling situations and products to assess effectiveness
- prototyping design solutions
- full realization and trialing of a design solution
- developing a marketing strategy.

The topic should be treated at an appropriate level of study:

- broad enough to have wider social, political or organizational aspects
- specific enough to have potential for taking or stimulating action in the problem area.

Students should identify the key issues that emerge from the investigation and assess their significance in relation to the original proposition or question. It is essential that students choose an issue that can be explored, and from which conclusions can be drawn, evaluated and recommendations made.

Examples of topics, research questions and suggested approaches

Once students have identified their topic and written their research question, they can decide how to research their answer. They may find it helpful to write a statement outlining their broad approach. These examples are for guidance only.

Topic	The factors involved in designing an ergonomic drinking cup for children
Research question	How have ergonomic factors been considered in the design of a drinking container for a pre-school child?
Approach	Primary data would be collected initially by observation of children's behaviour using existing drinking containers. Secondary ergonomic data would be used in the design, manufacture and evaluation of a prototype.

Topic	The impact of new materials on the design of modern racing bicycles
Research question	How effective would an integrated cycling network be for encouraging individuals or families to make journeys by bicycle and reduce pollution and congestion?
Approach	Primary data would be collected from the chosen city by field observation and questionnaire. Secondary research from successful cities that have implemented bikeways, street furniture and trip-end facilities would be used to plan, model and evaluate improvements.

Topic	Bedroom clock design for a nursery
Research question	What is needed in a bedroom clock to encourage a child to have a restful sleep?
Approach	An investigation of the factors needed in a clock that provides light and comfort but encourages the child to sleep and know when it is time to wake up. Primary data would be provided by observation and interview. Secondary data from research about existing children's lights, toys and sleeping patterns.

Topic	The impact of vertical wall gardens on the environment
Research question	To what extent can plants be grown on vertical surfaces to improve our build environment and counteract rising temperatures in cities?
Approach	Researching secondary data would provide evidence of rising temperature in cities and the need for green spaces to improve the aesthetics and the living/working environment. An examination of existing systems for attaching and growing plants on vertical walls would lead to the development of a prototype and its evaluation.

An important note on "double-dipping"

Students must ensure that their EE does not duplicate other work they are submitting for the Diploma Programme.

The design technology EE and internal assessment

An EE in design technology is not an extension of the internal assessment (IA) task. Students must ensure that they understand the differences between the two.

- Students may not use the same materials that have been used in the IA as the focus for their EE.

- Any data that has been generated for use in the IA is inadmissible for use in the EE.

Supervisors play an important role in guiding students on these distinctions. Students risk their diploma if academic misconduct is detected.

Interpreting the EE assessment criteria

Criterion A: Focus and method

(Strands: Topic, Research question, Methodology)

The topic must be clearly indicated at the start of the essay. Students should specify the area of the research and the purpose and focus of the essay to clearly establish the research question.

It is usually appropriate to include the general background and context required to understand how the research question has arisen. Take, for example, the topic “Ergonomics and design for disability”: students’ explanation of this topic may refer to independent living, ergonomics and potential markets.

The research question is best expressed in the form of an actual question. This should be the precisely formulated, focused question that the research will attempt to answer. The research question for “Ergonomics and design for disability” could be “What are the requirements for a wheelchair for indoor mobility that is suitable for use in a shower?”

The research question should be:

- identified clearly
- justified
- set out prominently at the start of the essay.

Students need to show that they have:

- adequately researched the topic and consulted an appropriate range of sources

- planned their research well
- chosen methods and materials appropriate to the research question
- used the design cycle to address the research question.

This applies both to literature research and to practical data collection. Students must demonstrate that their chosen methods and materials are appropriate for addressing the research question. If students use practical methods to collect data, they must explain their rationale for doing this.

For experimental work, they must provide sufficient information on their methodology to allow the work to be repeated. If the method requires modeling or prototypes, these need to be manufactured to a sufficient standard to collect useful data and allow evaluation.

Students must also clearly demonstrate their understanding of the methods and equipment used. They should clearly reference any processes and give supporting evidence as to why they used them.

If students are investigating a well-documented or standard topic, they should attempt to look for a new approach or perspective to the issue.

Criterion B: Knowledge and understanding

(Strands: Context, Subject-specific terminology and concepts)

The source materials accessed should be clearly relevant and appropriate to the research question and to the field of design technology. There may be some research questions that require background from other disciplines. However, care should be taken when doing this, as the essay will only be judged on its design technology content. For example, a student completing an EE on the topic area “New materials for designing aircraft fuselages” must apply their knowledge through the materials science and design area and not apply knowledge to the general increase in passenger air traffic resulting from cheaper air fares.

The essay should be effectively referenced and these references incorporated into the main body of the essay in a way that demonstrates the students’ understanding. Literature cited should predominantly come from acknowledged design, technology and scientific sources.

Students need to show a mastery of, and fluency in, the use of appropriate terminology. At the same time, students need to avoid excessive use of jargon.

Any technical terms that are used should be explained and the student must demonstrate an understanding of these terms by using them appropriately within the text.

The student must try to maintain a consistent linguistic style throughout the essay.

Criterion C: Critical thinking

(Strands: Research, Analysis and Discussion and evaluation)

The “research” refers to both literature sources and data collected by the students themselves. This research must be consistently relevant to the research question.

Students must demonstrate the ability to apply their selected sources and methods effectively and coherently in support of their argument.

The student must comment reflectively on the quality, balance and quantity of their sources.

Students are expected to show an awareness of any limitations or uncertainties inherent in their approach. In particular, they should critically comment on the validity and reliability of the data and methods they use within the investigation.

The student is expected to present and analyze the data and sources appropriately. This analysis will often include:

- details of performance
- attribute analysis
- tables of processed data
- images and graphs.

If performance tests are used, they will yield quantitative data. The student should show understanding of why the test is included and what the results mean.

If graphs are used, they must be correctly selected and drawn to illustrate key elements of the analysis. They should only be included if they improve communication.

Photographic images, sketches and design drawings should be clearly identified and annotated.

Students must present and analyze their data in such a way that they support and clarify the argument leading to the conclusion.

Students must sustain a reasoned, logical argument that focuses on the research question. Essays that attempt to deal with a large number of variables are unlikely to be focused and coherent. A clear and logical argument can be achieved by making frequent reference to the research question.

An assessment of the extent to which the hypotheses are supported, or the design question is answered, by the data or information accessed should form part of the argument.

Students should keep their question(s) focused, to avoid a tendency to expand arguments, generalize discussion and lose focus and relevance.

The stated conclusion(s) must be a synthesis based on the data, information and evidence presented in the essay rather than a repetition of earlier arguments. Minor inconsistencies should be reported but should not prevent a valid conclusion.

The data must be analyzed and presented in such a way that the argument leading to the conclusion is supported and clarified. Tables of raw data will generally not achieve this on their own. Raw data must be analyzed, processed and presented in a way that relates clearly and directly to the research question. Errors and uncertainties arising from the methodology, equipment or techniques should be analyzed and critically evaluated.

Designing solutions for real problems is a complex process, with factors that are difficult to control, and the design process may reveal unexpected outcomes. These should be pointed out, where appropriate, even if they were not part of the original plan.

The original research question may not be fully answered by the investigation. In these circumstances, the student should point out unresolved issues and make suggestions as to how these might be further investigated.

Criterion D: Presentation

(Strands: Structure, Layout)

This criterion relates to the extent to which the essay conforms to accepted academic standards in relation to how research papers should be presented. It also relates to how well these elements support the reading, understanding and evaluation of the essay.

Students may provide a section and subsection structure to their essays, with appropriate informative headings.

Use of charts, images and tables

Any images, design drawings or tables from literature sources included in the essay must be carefully selected and labeled. They should only be used if they are directly relevant to the research question, contribute towards the understanding of the argument and are of a good graphic quality.

Large tables of raw data collected by the student are best included in an appendix, where they should be carefully labeled. Tables of processed data should be designed to clearly display the information in the most appropriate form. Graphs or charts drawn from the analyzed data should be selected to highlight only the most pertinent aspects related to the argument. Too many graphs, charts and tables will distract from the overall quality of the communication.

Only processed data that is central to the argument of the essay should be included in the body of the essay, as close as possible to its first reference. Tables should enhance a written explanation but not themselves include significant bodies of text. If they do, then these words must be included in the word count.

Design drawings should follow accepted conventions for layout and labeling.

For experiments where numerical results are calculated from data obtained by changing one of the variables, it is generally good practice to show one example of the calculation. The remainder can be displayed in tabular or graphical form.

If a manufacturing or investigative method is long and complex, students may place the protocol in an appendix and just include a summary of the methods in the body of the essay. Students who choose this option must be careful to ensure that the summary contains all elements that contribute to the quality of the investigation, since appendices are not an essential section of the EE and examiners are not required to read them. In other words, any important information that contributes to the evaluation of the method must be in the body of the essay and not the appendix.

Any material that is not original must be carefully acknowledged, with specific attention paid to the acknowledgment and referencing of quotes and ideas. This acknowledgment and referencing is applicable to audiovisual material, text, graphs and data published in print and electronic sources. If the referencing does not meet the minimum standard as indicated in the guide (name of author, date of publication, title of source and page numbers as applicable), and is not consistently applied, work will be considered as a case of possible academic misconduct.

A bibliography is essential and has to be presented in a standard format. Title page, table of contents, page numbers, etc must contribute to the quality of presentation.

The essay must not exceed 4,000 words of narrative. Graphs, figures, calculations, diagrams, formulas and equations are not included in the word count. Students should be aware that examiners will not read beyond the 4,000-word limit, or assess any material presented thereafter.

Criterion E: Engagement

(Strands: Process, Research focus)

This criterion assesses the student's engagement with their research focus and the research process. It will be applied by the examiner at the end of

the assessment of the essay, and is based solely on the candidate's reflections as detailed on the *Reflections on Planning and Progress Form (RPPF)*, with the supervisory comments and extended essay itself as context.

Students are expected to provide reflections on the decision-making and planning process undertaken in completing the essay. Students must demonstrate how they arrived at a topic as well as the methods and approach used. This criterion assesses the extent to which a student has evidenced the rationale for decisions made throughout the planning process and the skills and understandings developed.

For example, students may reflect on:

- the approach and strategies they chose, and their relative success
- the *Approaches to learning skills* they have developed and their effect on the student as a learner
- how their conceptual understandings have developed or changed as a result of their research
- challenges they faced in their research and how they overcame these
- questions that emerged as a result of their research
- what they would do differently if they were to undertake the research again.

Effective reflection highlights the journey the student has engaged in through the EE process. Students must show evidence of critical and reflective thinking that goes beyond simply describing the procedures that have been followed.

The reflections must provide the examiner with an insight into **student** thinking, creativity and originality within the research process. The **student** voice must be clearly present and demonstrate the learning that has taken place.