Course Companion

# International Baccalaureate · IB Diploma · Digital Society · HL

Every topic handout in one volume

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# Data, algorithms and digital power

International Baccalaureate · IB Diploma · Digital Society · HL

IB Diploma Programme Digital Society HL (first assessed in 2024). The course looks at how **digital systems** change people's lives. It joins three parts: seven **concepts** (the questions you ask), seven **content** areas (the technology you study) and seven **contexts** (the parts of life where it matters). This topic covers the concepts and the first two content areas, data and algorithms. They are examined in Paper 1 (2 hours 15 minutes, 35% at HL; 1 hour 30 minutes, 40% at SL), where questions ask about the course and about **real-world examples** .

In 2020 the COVID-19 pandemic cancelled England's A-level exams. Instead, a formula decided students' grades. It took each school's results from earlier years and each teacher's ranking of their students, and fitted this year's class to the old pattern. On results day, almost 40% of the grades that teachers had predicted were lowered. A strong student in a school with weak past results could not get the top grade, because the school "never" got it. Students protested in the streets with signs against "the algorithm", and four days later the government dropped the formula and used the teachers' grades instead. A few lines of rules had decided the futures of thousands of young people. This is what digital society studies.

**Must-know for data, algorithms and digital power**:

| Area | Key content |
|---|---|
| course structure | concepts, content and contexts, joined through inquiry |
| concepts | change, expression, identity, power, space, systems, values and ethics |
| data (3.1) | data and information; collecting, processing and storing; privacy |
| algorithms (3.2) | inputs, rules and outputs; bias in, bias out |
| inquiry | concept + content + context + real-world example = a focused question |
| Paper 1 | questions on the course, always with real-world examples |

## The course: concepts, content and contexts

| Concepts (2.1–2.7) | Content (3.1–3.7) | Contexts (4.1–4.7) |
|---|---|---|
| change | data | cultural |
| expression | algorithms | economic |
| identity | computers | environmental |
| power | networks and the internet | health |
| space | media | human knowledge |
| systems | artificial intelligence | political |
| values and ethics | robots and autonomous technologies | social |

You do not study these 21 items one by one. Every inquiry takes one or two from each column and joins them to a real case.

## Seven concepts as questions

A concept is a question you ask about a case:

| Concept | The question it asks | Asked about the 2020 grades |
|---|---|---|
| **change** | is this a small step (evolution) or a big break (transformation)? | was a formula a new way to grade, or the old exam system in a new form? |
| **expression** | who can speak, and how far does it travel? | how did students' protests reach the government in four days? |
| **identity** | how does it shape who we are? | a student became "a rank in a school's history" |
| **power** | who decides, and who benefits? | teachers, the exam board or the formula's designers? |
| **space** | how does it change places and distances? | where you went to school mattered more than what you did |
| **systems** | how do the parts work together? | schools, data, the formula and universities as one chain |
| **values and ethics** | is it fair, right and acceptable? | is it fair to judge a person by other people's past results? |

## Data

**Data** are raw facts: numbers, words, times, places. **Information** is data that has been organised so that it means something. A smartwatch records your heart rate as data (72, 75, 140, 138...); "your heart rate rose sharply during your run" is information.

Every dataset has makers, who decided three things:

- **Collection** : what is recorded, and what is left out. A ranking records the teacher's order of students, not how hard each one worked during the pandemic.
- **Processing** : cleaning, joining and analysing the data.
- **Storage** : who keeps the data, where and for how long.

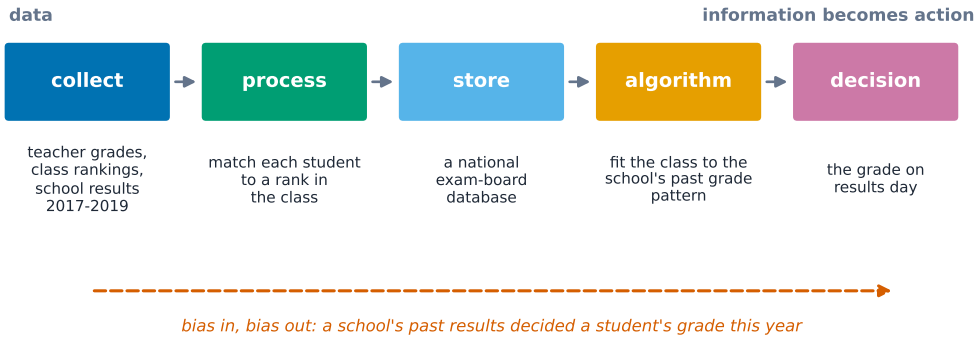
Data about people raises questions of **privacy** . In 2014 a personality-quiz app on Facebook was used by about 270,000 people, but it also collected data about their friends. The data of up to 87 million people reached the political consulting firm Cambridge Analytica, which used it to target political advertising. Most of those people had never used the app. In 2019 the US Federal Trade Commission fined Facebook US$5 billion for its privacy failures. Data collected for one purpose (a fun quiz) was used for another (political campaigns).

## Algorithms

An **algorithm** is a set of step-by-step rules that turns inputs into outputs, like a recipe. Algorithms decide what appears in your video feed, which route a map app suggests and whose job application is read.

The key idea: **bias in, bias out**. An algorithm learns from or uses data from the past, so it can repeat the unfairness of the past. Two examples:

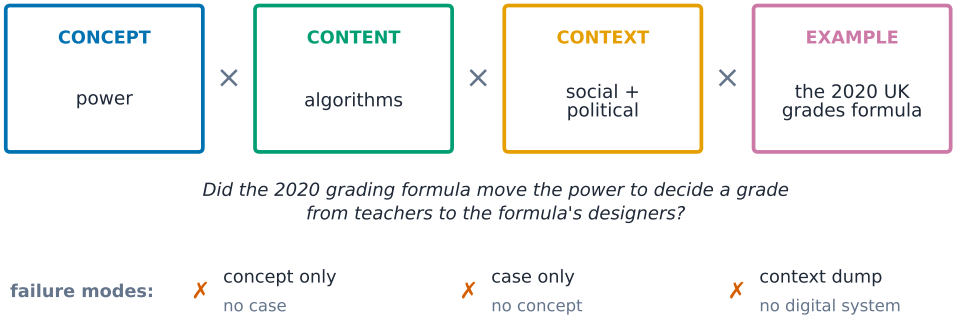
- The 2020 grading formula used each school's past results as an input, so students at schools with weaker histories were held down, whatever their own work.
- Amazon tested a computer system for choosing job applicants, trained on ten years of CVs, most of them from men. It learned to give lower scores to CVs that included the word "women's" (as in "women's chess club"). Amazon stopped using it (Reuters reported this in 2018).




*Each stage has makers; bias that enters at the start reaches the decision at the end.*

## Focusing an inquiry

A good inquiry joins all four parts: a **concept**, a **content** area, a **context** and a real-world example. Together they make a focused question.




*All four parts at once make a question worth asking; drop one and the inquiry fails.*

> **Worked example.** Power (concept) + algorithms (content) + social and political contexts + the 2020 UK grading formula = "Did the formula move the power to decide a grade from teachers to the formula's designers?"

Three common mistakes:

- **Concept only**: an essay about power in general, with no real case.
- **Case only**: the story of 2020, with no concept to explain it.
- **Context dump**: a lot about schools and politics, but no digital system in view.

## Answering Paper 1

Paper 1 questions range from short answers to extended responses. The IB's own examples:

| Command term | Example question |
|---|---|
| identify | identify different types of existing AI |
| outline | outline the ways that data is different from information |
| describe | describe a context and real-world example in which collecting data about online activity may pose privacy concerns for young people |
| examine / discuss / evaluate | examine the claim that online social media fosters greater tolerance for diverse backgrounds and experiences |

For a long answer: define the key terms; name the concept, content and context you are using; explain one or two real-world examples in detail (who, where, when, what happened); give more than one perspective; and end with a judgement.

**Worked plan.** *Describe a context and real-world example in which collecting data about online activity may pose privacy concerns for young people.*

- Context: political (or social).
- Example: the Cambridge Analytica case: a quiz app collected data about its users' friends, who never agreed.
- Concern: young people share likes and friend lists freely; they may not know that the data can be moved and used to target them.
- Link: data collected for one purpose was used for another (data, 3.1), which is a question of power and of values and ethics.

## Checklist

- Concepts, content and contexts: seven of each, joined through inquiry.
- Each concept as a question, applied to the 2020 grades.
- Data and information; collection, processing, storage; privacy and Cambridge Analytica.
- Algorithms as rules; bias in, bias out; the grading formula and Amazon's hiring system.
- The four-part focused question and the three common mistakes.
- Paper 1 command terms and the worked plan.

# Networks, media and automation

International Baccalaureate · IB Diploma · Digital Society · HL

IB Diploma Programme Digital Society HL (first assessed in 2024). This topic covers the other five content areas: **computers** (3.3), **networks and the internet** (3.4), **media** (3.5), **artificial intelligence** (3.6) and **robots and autonomous technologies** (3.7). It also teaches how to work with **sources**, which you need for Paper 2 (1 hour 15 minutes; 20% at HL, 30% at SL), a paper of questions on sources you have not seen before.

In March 2011 an earthquake and tsunami damaged the Fukushima nuclear power station in Japan. Within days, a rumour spread across China by text message and social media: iodised salt protects you from radiation, and soon the sea would be polluted, so there would be no more salt. People queued outside shops and bought bags and bags of salt; in some cities the shelves were empty. The rumour was false: eating salt does not protect against radiation, and China had large salt reserves. A false claim had travelled faster than the truth through a network of phones. This topic asks how that happens.

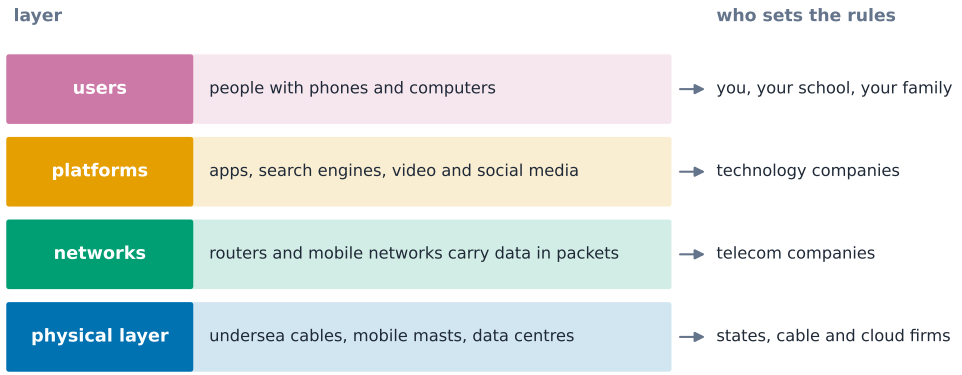
**Must-know for networks, media and automation**:

| Area | Key content |
|---|---|
| computers (3.3) | hardware and software; more power, less size and cost |
| networks (3.4) | the internet as a network of networks; cables, data centres, platforms |
| media (3.5) | everyone can publish; feeds ranked by engagement; misinformation |
| AI (3.6) | machine learning; narrow and general AI |
| robots (3.7) | machines that sense, decide and act; who is responsible? |
| sources | claim, perspective and origin; Paper 2 |

## Computers and networks

A computer runs **software** (instructions) on **hardware** (the physical machine). For decades the number of transistors on a chip roughly doubled every two years, so computers became smaller, cheaper and more powerful. A smartphone today is a powerful computer that most people carry everywhere.

The **internet** is a network of networks. Data travels in small packets through routers, and almost all data between continents travels through cables on the sea floor. At each layer someone has control: the companies that own the cables and **data centres**, the platforms (the apps and websites people use) and the governments that make rules. Whoever controls a layer can set its rules, and that is a question of power.



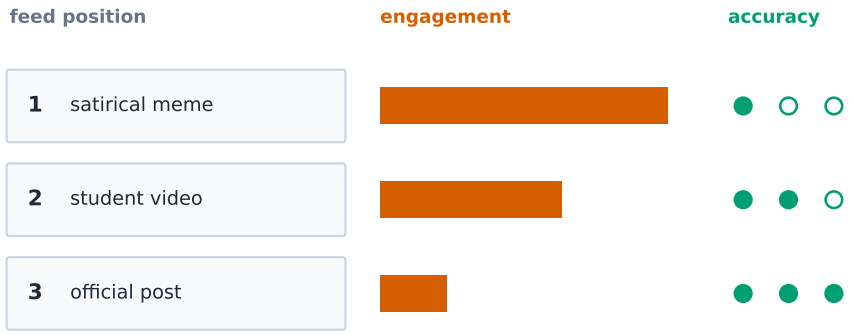

*Each layer has owners, and each owner can set rules for the layers above it.*

## Media

Digital media changed three things:

- **Creation**: anyone with a phone can publish text, photos and video.
- **Distribution**: a feed is ranked by an algorithm, usually by **engagement** (likes, shares, comments, time watched), not by date or by accuracy.
- **Participation**: users comment, share, remix and join campaigns.

**Misinformation** is false information shared by people who believe it, like the salt rumour. **Disinformation** is false information spread on purpose to deceive. A 2018 study in the journal *Science* looked at about 126,000 stories shared on Twitter: false stories spread further and faster than true ones, and true stories took about six times as long to reach 1,500 people. False news is often new and surprising, so people share it.




The ranking rule reads engagement only, so the least accurate version travels furthest (schematic).

*The feed ranks by engagement, so the least accurate version rises to the top.*

## Artificial intelligence

Artificial intelligence is computer systems doing tasks that usually need human intelligence, such as recognising faces, translating or writing. Most modern AI uses **machine learning** : instead of following rules written by a programmer, the system finds patterns in large amounts of data.

| Type | What it can do | Example |
|---|---|---|
| **narrow AI** | one task, or one kind of task | face unlock on a phone; a translation app; AlphaGo, which beat the Go champion Lee Sedol 4–1 in 2016 |
| **generative AI** | produces new text, images or sound from patterns in its data | ChatGPT (2022), image generators |
| **general AI** | any task a human can do, at human level | does not yet exist |

AI raises questions in every context: who owns the data it learned from (economic), whether its answers are true (human knowledge), and whether it treats groups fairly (social).

## Robots and autonomous technologies

A **robot** is a machine that senses its surroundings, makes decisions and acts in the physical world. An **autonomous** technology acts without a human controlling each step: a warehouse robot, a delivery drone, a self-driving car. Since 2022 Baidu's Apollo Go robotaxis have carried passengers with no safety driver in parts of Wuhan and other Chinese cities.

When an autonomous machine makes a mistake, who is responsible? In March 2018 a self-driving test car run by Uber hit and killed a woman crossing a road in Tempe, Arizona. The car's sensors detected her seconds before the crash but the system did not brake, and the safety driver in the car was looking at a phone. Was the fault the driver's, the company's, the programmers', or the car's? Autonomy moves decisions away from people, but responsibility still has to land somewhere.

## Working with sources

Paper 2 gives you sources: texts, images, charts and data. Read each one for three things:

| Ask | Question | Salt rumour example |
|---|---|---|
| **claim** | what does the source say? | a message says iodised salt protects against radiation |
| **perspective** | who made it, and what are their interests? | an anonymous forwarded text; a government health notice; a scientist |
| **origin and purpose** | where, when and why was it made? | made in panic, to warn friends, with no evidence |

Then compare: where do the sources agree or disagree, and which is more reliable? Diverse sources means really different perspectives (users, companies, governments, researchers), not several sources that all say the same.

Paper 2 questions usually move from finding information in one source, to explaining and comparing sources, to a longer answer that uses the sources together with your own knowledge and real-world examples.

**Worked plan.** *Using the sources and your own knowledge, discuss whether social media makes false information more dangerous.*

- Sources: the 2018 *Science* study (researchers: false news spreads faster); a platform statement about labelling false posts (company: the problem is under control).
- Own example: the 2011 salt panic, which spread by text message as well as social media, so the problem is older than today's apps.
- Judgement: social media makes false information faster and wider, but ranking by engagement is the main cause, and it can be changed.

## Checklist

- Computers: hardware, software, growing power.
- Networks: a network of networks; cables, data centres, platforms; who controls each layer.
- Media: creation, distribution, participation; misinformation and disinformation; the 2018 *Science* study.
- AI: machine learning; narrow, generative and general AI.
- Robots: sense, decide, act; autonomy and responsibility (Tempe 2018).
- Sources: claim, perspective, origin and purpose; the Paper 2 plan.

# The inquiry project

International Baccalaureate · IB Diploma · Digital Society · HL

IB Diploma Programme Digital Society HL (first assessed in 2024). The internal assessment is the **inquiry project** : your own investigation into the **impacts and implications** of one real digital system for people and communities. It is worth 30% at SL and 20% at HL, and the course gives about 30 hours to it. You submit three things: an **inquiry process document** , a recorded **multimedia presentation** (up to 10 minutes) and a list of **references** . The requirements are the same at SL and HL.

During the COVID-19 pandemic, people in China showed a green health code on their phones to take a bus, enter a shop or visit a hospital. For most people this took a few seconds. But in 2020 China had about 264 million people aged 60 or over, and many of them had no smartphone, or did not know how to use the app. News reports told of older people turned away from buses and stations. In November 2020 the State Council published a plan to help older people with smart technology: places had to offer other ways in, such as paper certificates or help from staff, and to keep accepting cash. A system that made life easier for most people had shut out others. Finding out who gains, who loses and why is exactly what an inquiry project does.

**Must-know for the inquiry project**:

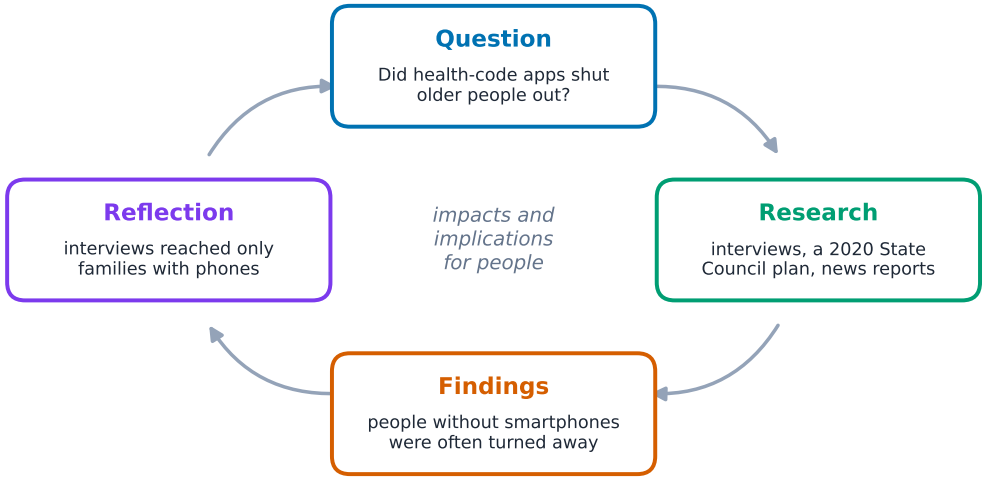
| Part | Key content |
|---|---|
| focus | one real digital system; one concept, content area and context; a focused question |
| research | diverse sources, primary and secondary; claim, perspective and origin |
| impacts and implications | what changed for whom; what it means next |
| process document | the record of your inquiry, written while it happens |
| presentation | recorded, up to 10 minutes, several modes, every claim sourced |
| references | every source listed |

## The inquiry cycle

The project follows a cycle:

1. **Question**: choose a real digital system that affects people you can find out about, and focus it with the four parts from topic 01: concept + content + context + real-world example.

2. **Research**: collect **primary sources** (your own interviews, surveys or observations) and **secondary sources** (news reports, studies, official documents).
3. **Findings**: explain the impacts (what has changed) and the implications (what follows from it, for whom).
4. **Reflection**: what your inquiry could not see, and what you would do next.




*The inquiry cycle, with the health-code project at each stage.*

**Impact or implication?** An **impact** is an effect that has happened ("older people without smartphones were turned away from buses"). An **implication** is what it means or may lead to ("public services that need an app may leave out whoever cannot use one, so they need a non-digital option").

## Worked project

- **System**: health-code apps in a Chinese city, 2020–2022.
- **Focus**: power and change (concepts) + data and networks (content) + social and health contexts. Question: "How did health-code apps change older people's ability to move around the city?"
- **Primary sources**: interviews with six grandparents (names changed, with their consent) and a bus driver.
- **Secondary sources**: the State Council's November 2020 plan; news reports; census figures on the older population.
- **Findings**: most interviewees relied on a grandchild to show the code; two stopped taking buses for some months; staff help became common after the 2020 plan.
- **Reflection**: everyone interviewed had a family member with a smartphone, so the people most shut out were not in the sample.

## Working with sources

Use the same three questions as in topic 02 (claim, perspective, origin and purpose), and look for real **diversity of sources**: the users, the people who run the system, the government and researchers. A source that disagrees with you is useful: show you have weighed it.

Research ethics matter. Ask people for their **consent** before you interview them, do not show faces or real names without permission, and never collect private data such as ID numbers.

## The process document

The inquiry process document is the record of how your inquiry developed. Write it *while* you work, not at the end:

- why you chose this system and this focus;
- the sources you found, and what you learned from each;
- the decisions you made: what you cut, changed or added, and why;
- the feedback you received (for example, from your teacher after a draft), and what you changed because of it.

## The presentation and references

The multimedia presentation is recorded, and lasts up to 10 minutes. It should argue, not just show. Use several modes: your spoken explanation, a chart of your survey results, a short clip or photo of the system in use. Show the source of every claim and image on screen. The list of references gives full details for every source you used.

**Common mistakes:**

- a read-aloud essay with no visuals, or a montage of images with no argument;
- a topic that is too wide ("social media and young people");
- describing the technology without its impacts on people;
- sources that all say the same thing, or no sources on screen.

## Checklist

- 30% SL, 20% HL; three parts: process document, presentation (up to 10 minutes), references.
- A focused question on one real system: concept + content + context + example.
- Primary and secondary sources; diverse perspectives; consent.
- Impacts (what happened) and implications (what it means).
- The process document written during the inquiry.
- The worked health-code project.

# HL challenges and interventions

International Baccalaureate · IB Diploma · Digital Society · HL

IB Diploma Programme Digital Society HL (first assessed in 2024). Only HL students study the **HL extension** : three big **challenges** of digital society, and the **interventions** that try to answer them. The challenges are global well-being (5.1), governance and human rights (5.2) and sustainable development (5.3). Paper 3 (1 hour 15 minutes, 25% of HL) is built on a **pre-released brief** : some months before the exam, the IB publishes a short text about one challenge. In the exam, you answer questions about an intervention related to it.

In August 2021 China announced a new rule for online games: players under 18 could play for only one hour, from 8 to 9 pm, on Fridays, weekends and public holidays. Game companies had to check every player's real name and age. Many parents welcomed the rule. Many teenagers did not, and some found ways round it by using adults' accounts. Was the rule a good intervention? It depends on what you are measuring: did gaming time fall, was the rule fair to everyone, and did the people it affected accept it? Paper 3 asks exactly these questions.

**Must-know for the HL extension**:

| Area | Key content |
|---|---|
| global well-being (5.1) | health, attention, connection and loneliness online |
| governance and human rights (5.2) | who makes the rules for the digital world; privacy and expression |
| sustainable development (5.3) | energy, materials and e-waste; the digital divide |
| interventions | laws, designs, campaigns: what they change, for whom |
| evaluation | effectiveness, equity and acceptability; evidence and limits |
| Paper 3 | pre-released brief; 1 hour 15 minutes; 25% of HL |

## The three challenges

### Global well-being

**Well-being** means living a healthy, satisfying life. Digital systems can support it (online medical appointments, staying in touch with family far away) and harm it (sleep lost to phones, online bullying, comparing yourself with others). Many apps are designed to keep people using them as long as possible, because their income comes from attention and advertising.

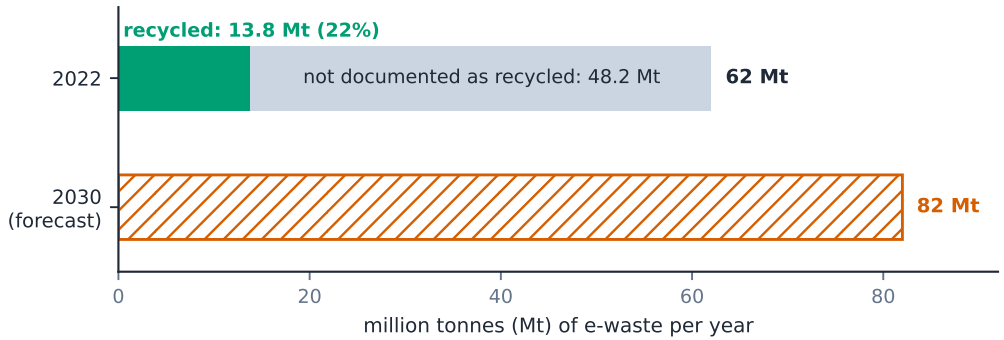
### Governance and human rights

**Governance** asks who makes and enforces the rules. Digital systems cross borders, and the platforms that run them are often richer than many countries. **Human rights** at stake include privacy and freedom of expression. Two real laws:

- The European Union's **General Data Protection Regulation** (GDPR, 2018) gives people rights over their personal data, such as seeing what a company holds about them. Companies that break it can be fined up to 4% of their worldwide yearly turnover.
- China's **Personal Information Protection Law** (in force from November 2021) also requires consent to collect personal information, with stricter rules for sensitive information such as health data and children's data.

### Sustainable development

**Sustainable development** meets today's needs without damaging the future. Digital technology uses electricity (data centres run day and night) and materials (metals mined for phones and batteries), and it becomes waste. The world produced about 62 million tonnes of **e-waste** in 2022, and only about 22% of it was properly collected and recycled (Global E-waste Monitor 2024), and the report expects 82 million tonnes a year by 2030. The **digital divide** , the gap between people who can and cannot use digital technology, is a development question too.




*E-waste is growing faster than recycling: most of it is not documented as recycled.*

## Reading an intervention

An intervention is a deliberate action on a challenge: a law, a change in a product's design, or a campaign. For any intervention, ask:

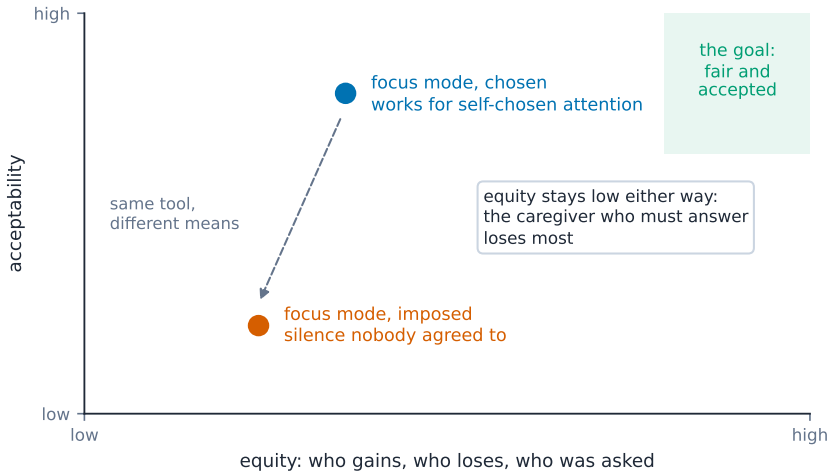
| Question | The 2021 gaming rule |
|---|---|
| what does it change? (the mechanism) | game companies must check real names and limit under-18 play time |
| who acts, and who is affected? | the government sets the rule; companies apply it; young players and families live with it |
| what does it claim to achieve? | less gaming addiction, more sleep and study time |
| what evidence is there? | company reports of lower play time by minors; surveys; reports of rule-breaking |

A second example, from design: the EU now requires new phones sold there to use the same USB-C charging port (from the end of 2024), so that people need fewer chargers and produce less e-waste.

## Evaluating effectiveness

The IB's sample question asks you to evaluate an intervention "in terms of equity and acceptability":

- **Effectiveness** : does it achieve its aim? What does the evidence show, and what can't it show?
- **Equity** : who gains and who loses? Is anyone left out or harmed more than others?
- **Acceptability** : do the people affected accept it? A limit people choose for themselves (such as a phone's focus mode) is usually more acceptable than one imposed on them.




*Judge an intervention on both axes; choice raises acceptability but does not fix equity.*

**Worked plan.** *Evaluate the effectiveness of the 2021 limit on minors' online gaming in terms of equity and acceptability.*

- Effectiveness: companies reported much lower play time by registered minors; but some teenagers used adults' accounts, which the figures cannot see.
- Equity: the rule applies to every registered minor in the same way; but teenagers whose parents lend them accounts escape it, and young people who used games to stay in touch with friends lost more than others.
- Acceptability: high among many parents, lower among teenagers, who were not asked; acceptability differs between groups.
- Judgement: effective for most registered players, less effective for the heaviest gamers who find ways round it; a combination of the limit with family agreements and better game design might work better.
- Limits of the evaluation: the evidence comes mainly from the companies and the government; independent data is limited.

## Answering Paper 3

1. Before the exam, study the pre-released brief: the challenge, the people affected and real interventions related to it.
2. In the exam, read the intervention carefully: mechanism, actors, aims, evidence.
3. Use course concepts (power, values and ethics, systems) and other real-world examples you have studied.
4. Reach a clear, balanced judgement that names its limits and suggests an improvement.

## Checklist

- The three challenges: well-being, governance and human rights, sustainable development.
- GDPR and China's Personal Information Protection Law; e-waste and the digital divide.
- Reading an intervention: mechanism, actors, aims, evidence.
- Effectiveness, equity and acceptability; the worked gaming-rule plan.
- Paper 3: the pre-released brief; four steps.