N19/3/ITGSX/BP2/ENG/TZ0/XX/M

Diploma Programme
Programme du diplôme
Programa del Diploma

Markscheme

November 2019

Information technology in a global society

Higher level and standard level

Paper 2

14 pages

Using assessment criteria for external assessment

For external assessment, a number of assessment criteria have been identified. Each assessment criterion has level descriptors describing specific levels of achievement, together with an appropriate range of marks. The level descriptors concentrate on positive achievement, although for the lower levels failure to achieve may be included in the description.

Examiners must judge the externally assessed work at SL and at HL against the four criteria (A–D) using the level descriptors.

- The same assessment criteria are provided for SL and HL.
- The aim is to find, for each criterion, the descriptor that conveys most accurately the level attained by the candidate, using the best-fit model. A best-fit approach means that compensation should be made when a piece of work matches different aspects of a criterion at different levels. The mark awarded should be one that most fairly reflects the balance of achievement against the criterion. It is not necessary for every single aspect of a level descriptor to be met for that mark to be awarded.
- When assessing a candidate's work, examiners should read the level descriptors for each criterion until they reach a descriptor that most appropriately describes the level of the work being assessed. If a piece of work seems to fall between two descriptors, both descriptors should be read again and the one that more appropriately describes the candidate's work should be chosen.
- Where there are two or more marks available within a level, examiners should award the upper marks if the candidate's work demonstrates the qualities described to a great extent. Examiners should award the lower marks if the candidate's work demonstrates the qualities described to a lesser extent.
- Only whole numbers should be recorded; partial marks, that is fractions and decimals, are not acceptable.
- Examiners should not think in terms of a pass or fail boundary, but should concentrate on identifying the appropriate descriptor for each assessment criterion.
- The highest level descriptors do not imply faultless performance but should be achievable by a candidate. Examiners should not hesitate to use the extremes if they are appropriate descriptions of the work being assessed.
- A candidate who attains a high level of achievement in relation to one criterion will not necessarily attain high levels of achievement in relation to the other criteria. Similarly, a candidate who attains a low level of achievement for one criterion will not necessarily attain low achievement levels for the other criteria. Examiners should not assume that the overall assessment of the candidates will produce any particular distribution of marks.
- The assessment criteria must be made available to candidates prior to sitting the examination.

Theme: Health

Criterion A — The issue and stakeholder(s) **[4]**

1. (a) Describe **one** social/ethical concern related to the IT system in the article.

[1]*: for identification of the concern (which does not have to be explicitly named).*

[2]*: there needs to be an explicit description of the impact/result/consequences/effect/outcome on the trainee surgeon, senior doctor, patient, hospital administrators, VR developers.*

Social/ethical concerns may include:

- Reliability and accuracy of simulations: computerized video simulations instead of real surgery videos used on simulations – Possible impact may provide an inferior learning environment for the trainee surgeon
- Reliability such as the delay to capture the trainee's movement; Possible impact: may negatively affect the trainee's performance & learning experience, reliability/accuracy of sensors – Possible impact: may not give accurate readings and negatively affect trainee's assessment
- People and machines: trainees relying too much on virtual training and not being exposed enough to real surgeries – Possible impact: trainee surgeons may only experience limited surgical cases and not be well prepared for surgery
- Digital divide – not all hospitals have access to virtual training; cost of VR equipment; need of strong network infrastructure – Possible impact: patients in remote areas may not benefit from surgeons who have undergone this training
- Digital divide – Not enough simulations/number of sessions for trainee – Possible impact: Insufficient sessions mean that trainees are not exposed to a wide variety of situations
- Policies – create policies that protect the anonymity of the trainee surgeons regarding the sharing of recordings – Possible impact: their initial attempts at surgery may negatively affect job prospects.

(b) Describe the relationship of **one** primary stakeholder to the IT system in the article.

***[1]**: **Who** – identification of the stakeholder.*

***[2]**: **What** are they doing with the IT system and **Where** in the IT system (technical part).*

Primary stakeholders may include:

- trainee surgeon who uses VR simulated surgeries to gain surgical skills
- trainee surgeon who reviews captured video during the training session to analyse the procedure/get feedback on their performance
- senior surgeon (Dr Gerber) who use VR-simulated surgeries to train trainee surgeons
- senior surgeon (Dr Gerber) who reviews the captured videos to analyse trainees' performance and plan further training
- senior surgeon (Dr Gerber) who shares the captured videos to use in training lectures
- hospital administrator who provides both VR equipment and network infrastructure
- IT Department staff in the hospital who must be trained on the use and functionality of VR equipment to give IT support to senior and trainee surgeons
- developers of VR simulated surgeries who work on updates and improvements to the VR system.

Add any additional marking notes here.

Marks	Level descriptor
0	The response does not reach a standard described by the descriptors below.
1	Either an appropriate social/ethical concern **or** the relationship of **one** primary stakeholder to the IT system in the article is identified.
2	Either an appropriate social/ethical concern **or** the relationship of **one** primary stakeholder to the IT system in the article is described **or** both are identified.
3	Either an appropriate social/ethical concern **or** the relationship of **one** primary stakeholder to the IT system in the article is described; the other is identified.
4	Both an appropriate social/ethical concern **and** the relationship of **one** primary stakeholder to the IT system in the article are described.

Criterion B — The IT concepts and processes **[6]**

2. (a) Describe, step-by-step, how the IT system works.
IT system: Virtual reality headsets, screen capture software, hand controls and sensors.

Add description of the steps for this IT system.

***[1]**: The student may show some understanding of the process but not in a step by step approach – using the information in the article and possibly some steps missing.*

***[2]**: The student is able to provide a logical step by step account using the information in the article but lacks some details. Must contain at least two major steps from the article. No developments present. Best fit if contains developments/information beyond the article but not in step by step.*

***[3]**: The student is able to provide a step by step account which may be detailed It must contain at least two steps that go beyond the Article.*

***[4]**: At least four technical developments that go beyond the Article.*

Answers provided in the article include:
VR Headset and Handset
- follow Guided audio instructions on the simulation
- move hand control to perform simulated surgery
- sensors (haptic) to detect touch and pressure on the surgical instruments
- move head to capture the 360 degree surrounding if necessary.

Recording of the procedure
- initiate screen capturing software
- 2D Image from screen is recorded
- training session is saved locally and then resaved to hospital server
- captured video is downloaded and analysed by senior surgeons and by trainee
- captured video is shared and used as a training tool.

Answers with additional information to that in the article may include:

VR Headset

- log in to select type of training and to enter personal details
- place headset on head;
- place handset
- load the selected operation
- get reaction from movement such as head tracking
- accelerometer picks up details of the rapidity of the trainee's hand movements
- sensors allow the duration of the different actions during the operation to be calculated
- surround audio recreate body sounds and body reaction to trainees' movements
- IR sensors monitor the eye movements
- image reacts according to the movements detected by the sensors
- audio changes according to the head movements
- trainee's pulse rate recorded to indicate the effect on them during the operation.

Recording of the procedure

- uploading to the cloud
- sharing of information via secure web platform with other hospitals to act as a teaching tool.

(b) Explain the relationship between the IT system and the social/ethical concern described in **Criterion A**.

Explaining the link between the concern and specific parts, or whole, of the IT system means the student must include how and why the concern has arisen from the use of the IT system. The naming of the concern identified in Criterion A may be implicit.

*Q2(b) clearly asks for a link to Q1(a), but the link only needs to be generic – eg for a specific security concern described in Q1(a), then in Q2(b) the student can explain a security weaknesses without reference to the specific concern in Q1(a). If the concern addressed in Q2(a) is completely different from that in Q1(a) a link cannot be made and hence **[0]**.*
Q2(b) can also be related back to Q1(b) where the who and what and where of the IT system usage are described.

***[1]**: If the student identifies the relationship between the concern and the IT system. This may be a repeat/rewording, of the response to Q1(a) or lack of detail for the how and why.*

***[2]**: How and why the concern can happen must be described in technical IT and ITGS terms: eg privacy: responses need to specify how (technical) the data can be accessed (similar to some of the steps for Q2(a)) and why it has been allowed to be accessed (eg lack of privacy settings – weakness with the technology).*

Answers may include:
- reliability – the latency of the system, does the system react quickly enough to the hand movements of the trainee surgeon. Why: sensors are not accurate
- reliability – the accuracy of the sensors, do the sensors accurately record the head and hand movements of the trainee. Why: not well positioned/adapted to trainee's head/hand; trainees' sweat affects readings, etc
- reliability – the accuracy/detail of the VR environment. Why: sound is not clear; image on screen is distorted
- digital divide – the network infrastructure that may not be able to support the VTR system / bandwidth. Why: simulators images and software are heavy and require lots of storage space
- digital divide – power hungry and processor hungry system. Need of extra space to save all sessions and simulations. Why: videos will be used for future training and need to be saved
- digital divide – may not be able to get technical support for hardware/software as the technology is cutting edge. Why: lack of trained technical staff in certain countries/areas
- policies – create policies that protect the anonymity of the trainee surgeons regarding the sharing of recordings, Why lack of safe authentication of trainee and safe storage of logon details and recordings
- policies – one that addresses the legal issues that are associated with newly qualified surgeons who have been trained using the VR system rather than the "traditional" approach. Why not enough face-to-face training.

Candidates are expected to make reference of the relevant stakeholders, information technologies, data and processes. Candidates will be expected to refer to "how the IT system works" using appropriate IT terminology.

Marks	Level descriptor
0	The response does not reach a standard described by the descriptors below.
1–2	There is little or no understanding of the step-by-step process of how the IT system works and does not go beyond the information in the article. The major components of the IT system are identified using minimal technical IT terminology.
3–4	There is a description of the step-by-step process of how the IT system works that goes beyond the information in the article. Most of the major components of the IT system are identified using some technical IT terminology. The relationship between the IT system referred to in the article and the concern presented in criterion A is identified, with some use of ITGS terminology.
5–6	There is a detailed description of the step-by-step process that shows a clear understanding of how the IT system works that goes beyond the information in the article. The major components of the IT system are identified using appropriate technical IT terminology. The relationship between the IT system referred to in the article and the concern presented in criterion A is explained using appropriate ITGS terminology.

Criterion C — The impact of the social/ethical issue(s) on stakeholders [8]

3. Evaluate the impact of the social/ethical issues on the relevant stakeholders.

Marking is to be done holistically focusing on determining the correct markband and then the level in the markband using the guidelines attached to each markband.

Impact = result/consequence/effect/outcome on stakeholder – positive and negative.

The evaluation should focus on the overall impact on all the stakeholders mentioned discussing the balance between the positive and negative impacts.

At least two stakeholders are required for entrance into the top markband.
***[1]**: One or two impacts identified.*

***[2]**: More than two impacts described of either type – positive or negative.*

***[3]**: Analysis by structure – division into groups eg positive/negatives and/or various Stakeholders.*

***[4]**: At least two negative and one positive impact for at least two stakeholders in order to provide a balanced analysis in the top markband. Only one stakeholder analysed or unbalanced analysis maximum of **[4]**.*

***[5]**: Must include **some linking analytical connections** (between positive/negatives, various stakeholders, various issues) and/or and **added evaluative comments** about the implications for stakeholders.*

***[6]**: Fully analysed and evaluated. Significant analytical connections and evaluation comments **require clear evidence of additional thinking beyond descriptions and structure**.*

***[7–8]**: A conclusion backed by direct reference to the impacts described is needed and not just a repetition or summary – it needs to be argued based on the evidence.*

Answers may include:
Trainee surgeon

Positive Impacts
- allows trainee surgeons to practice more often and repeat the simulation
- allows extreme and unusual scenarios to be practised
- can create simulated scenarios as and when unexpected situations arise
- is more ethical no need to practise on real patients at an earlier stage of training
- allows for mistakes to be made without negative consequences to patients and trainee surgeons
- can review the operations and use it as a basis for further training
- can share experiences with other trainees
- surgeons can be more risk takers and try different techniques
- available 24/7 allowing flexible training
- no need of supervision while on the simulator
- may provide more unbiased/accurate feedback to trainee.

Negative Impacts
- is not real and skills need to be transferred to the operating room
- may not develop communication skills with patients and other medical staff
- may be seen as a gaming experience, a false sense of security
- may not have the same importance as in real life, may desensitize trainee surgeons when dealing with real life situations
- limited training modules available
- reluctance to be recorded
- may be seen as surveillance
- allows for inaccuracies, but this may not be good enough in reality
- latency in system may be frustrating.

Senior doctors

Positive Impacts
- enables them to provide more training opportunities
- if performance is poor they can ask trainees to repeat the simulation
- may allow them to be more hands-off and monitor many trainees at once
- can review videos many times to pick up more subtle issues
- can evaluate trainees at their leisure
- can manage workload better
- can create their own scenarios based on local needs
- can experiment with new approaches
- can set difficulty levels.

Negative Impacts
- need to learn a new IT system
- may find resources are diverted to develop the new system
- may find that trainees need more input as the experiences in the VR system are not realistic enough
- may lead to a 24/7 workload as the trainees may want feedback at any time.

Hospital Administrators

Positive Impacts
- save on long term training resources
- surgeon trainees will have more experience in situations prior to real life situations
- perceived being cutting edge in medical technology
- share resources with other hospitals.

Positive Impacts
- initial startup cost
- costs to update resources
- more responsibility for IT department to maintain the system
- commitment to a system that can quickly be out of date.

VR Developers

Positive Impacts
- if successful, might get investment in innovations for the medical field
- if successful, will sell more simulations of other medical procedures
- if successful, may sell to other hospitals worldwide.

Negative Impacts
- must constantly work on updates and improvements to the VR system
- may get a bad reputation if sensors, headset or handset do not provide trainees with real-time experience.

Patients

Positive Impacts
- may feel confident that the surgeons have been exposed to a wide range of VR experiences.

Negative Impacts
- worries about the trainees not being trained in real-life situations.

Marks	Level descriptor
0	The response does not reach a standard described by the descriptors below.
1–2	The impact of the social/ethical issues on stakeholders is described but not evaluated. Material is either copied directly from the article or implicit references are made to it.
3–5	The impact of the social/ethical issues on stakeholders is partially analysed, with some evaluative comment. Explicit references to the information in the article are partially developed in the response. There is some use of appropriate ITGS terminology.
6–8	The impact of the social/ethical issues on stakeholders is fully analysed and evaluated. Explicit, well developed references to information in the article are made appropriately throughout the response. There is use of appropriate ITGS terminology.

Criterion D — A solution to a problem arising from the article **[8]**

4. Evaluate **one** possible solution that addresses at least **one** problem identified in **Criterion C**.

Problem must be specified here, but if this is not done here, it must be one of the impacts/problems identified in Criterion C. The ONE solution may refer to any of the problems. Mark the first solution only.

***[1]**: Solution is identified.*

***[2]**: Solution is described (what, who, where) and the link to article may be implicit, which could be a general description eg general policy description similar to that found in a textbook.*

***[3]**: The solution is applied to the problem directly and not generally – how and why it solves the problem (first positive evaluation). The solution must be feasible and can be applied to the problem, even if not good "quality".*

***[4–5]**: At least one more positive evaluation and at least one negative evaluation is required. Best fit if description is limited.*

***[6]**: Fully evaluated strengths and weaknesses requires a balance of at least two positive and two negative evaluations.*

***[7–8]**: Concluding paragraph directly referencing the evaluations. Students may propose future developments in response to the evaluations, such as solution/s to the negative evaluations, as part of the conclusion – best fit applies if included instead of discussion of evaluations.*

Best fit also applies if a student has not fully described the solution or provided the minimum four evaluations.

Answers may include:

- not realistic: Combining face-to-face with VR training
- not realistic: add more sensors (*eg*: haptic)
- not realistic: instead of computer generated images use footage of real operations/use scans *eg* MRI scans
- latency within the system: faster data transfer
- lack of immediate feedback: teaching information/instruction on the screen on how to proceed
- artificial pressure: introduce complications during the simulated operation
- initial expense: government funding or NGO funding
- rely on it instead of real training: policy on the qualification gained from the time spent on the simulator (minimum required hours either on simulator and real operations)
- lack of patient/doctor relationship: develop communication course/combine with face-to-face training
- lack of knowledge of the new system: training to be offered to all involved
- limited number of modules available: policies on the update and upgrading of modules
- static learning environment: incorporate AI to create an adaptive learning environment.

*If the evaluation does not provide any additional information to that in the article, the candidate will be awarded a maximum of **[2]**.*

Marks	Level descriptor
0	The response does not reach a standard described by the descriptors below.
1–2	**One** feasible solution to at least **one** problem is proposed and described. No evaluative comment is offered. Material is either copied directly from the article or implicit references are made to it.
3–5	**One** appropriate solution to at least **one** problem is proposed and partially evaluated. The response contains explicit references to information in the article that are partially developed. There is some use of appropriate ITGS terminology.
6–8	**One** appropriate solution to at least **one** problem is proposed and fully evaluated, addressing both its strengths and potential weaknesses. Areas for future development may also be identified. Explicit, fully developed references to the information in the article are made appropriately throughout the response. There is use of appropriate ITGS terminology.