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The Development of a Guideline in Assessing Students' Creation Video-Based Project in Programming Subject

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Abstract. Currently, many video-based assessments of students' practical and clinical works in several subjects, especially in the medical field, have been widely studied. However, studies that focus on such assessments of student learning of programming subject are seriously lacking. To make matters worse, there are no guidelines for teachers to implement such an assessment. Premised in this context, this research was conducted to develop a guideline for assessing students' video-based creation in programming subject. This study was based on a qualitative methodology comprising two phases. In the first phase, a structured interview involving ten computer science (ASK) teachers, who were randomly selected from a Malaysian public school, was carried out to help determine the essential components and subcomponents of the guideline. The results of the first phase were reviewed and refined during the second phase, which involved a focus-group discussion with seven experts from four relevant fields: computer science, information technology education and assessment, educational technology, and assessment, and multimedia. The five previously identified components were validated based on their expert judgement, and a number of new subcomponents were also identified, bringing the total number of subcomponents for the proposed implementation guideline up to 21. In practical terms, programming teachers can utilise this new guideline to evaluate their students' learning performance in programming subject based on their video creations in programming classes.

Keywords: assessment; guideline; video-based assessment; programming subject

1. Introduction

In today's academic environment, it is required of every student to gain the necessary skills and knowledge to enable a smooth transition into the working

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world. This calls for comprehensive academic curricula in which assessments are a crucial part of curriculum design that have a big impact on the teaching and learning process. This is consistent with the Malaysian Ministry of Education's 2016 plans, which introduced the New Classroom Assessment (Pentaksiran Bilik Darjah-PBD) to replace the old School Assessment (Pentaksiran Sekolah-PS), with the former placing a greater emphasis on the growth of students' learning progress while also assisting teachers in improving their teaching methods (Pentaksiran Bilik Darjah, PBD, 2022). In essence, the major goal of such assessments is to gauge how well pupils comprehend the material they have learned (Abujaja & Abukari, 2019). In this regard, Rivera & Heinrich (2016) assert that an assessment that focuses on students' learning outcomes based on their learning experiences that can help improve their skills in problem-solving, interpersonal communication, and conflict management, which are a necessary part of an effective teaching and learning process.

As a result, carrying out a precise and authentic assessment is crucial to the teaching and learning process. Additionally, using competency-based assessments has grown more important in today's educational environment since it requires students to show they have achieved the required learning outcomes. In this respect, the European Commission emphasises the need to create new evaluation techniques that can gauge students' active participation in and awareness of their learning, which encourages them to take ownership of their education (Neumann et al., 2019).

In this regard, a proper, systematic selection of assessment instruments is necessary to monitor students' progress toward meeting learning objectives. More crucially, regardless of the subject matter, such an evaluation should consider students' learning experiences that contribute to the achievement of the learning outcomes in addition to the prerequisites to accomplish those outcomes. Additionally, educators must think about how to carry out an evaluation that emphasises students' abilities to evaluate, analyse, create, and use these abilities to cope with new challenges and find and evaluate new solutions.

To date, there are no systematic guidelines for the assessment of student learning based on video, especially in the programming subject or course. Given this scarcity, this study, which was based on a qualitative approach, was carried out to address the following research objectives:
(a) To identify the components of a proposed guideline for assessing student learning in the programming subject based on video.
(b) To validate the appropriateness of components of the proposed assessment guideline.
Correspondingly, two research questions were formulated to help answer the above research objectives as follows:
(a) What are the main components and subcomponents of the proposed guideline for the video-based assessment of student learning in the programming subject?
(b) Are the identified components and subcomponents of the proposed guideline deemed appropriate?

2. Background

For the purpose of evaluating student learning, a number of technology-based assessments have been developed and deployed (Bārdule, 2021; Kapsalis et al., 2019; Kiersey et al., 2018; Neumann et al., 2019). Their use has recently increased as a result of the Covid-19 outbreak, which affected nearly all countries worldwide and forced them to turn to online teaching and learning activities. Malaysia is no different, as the country's Ministry of Higher Education has made it mandatory for all learning courses to be fully implemented online by the end of 2020 (Hafidzul Hilmi, 2020). Teaching and learning are gradually returning to the pre-pandemic levels as the pandemic has turned into endemic and regular physical classrooms are making a comeback. The epidemic has taught teachers, among other things, that they must be psychologically and physically fit in order to perform their tasks under any circumstances. In today's educational realm, virtually all students are particularly fond of and accustomed to the use of technology, so teachers must be digitally knowledgeable to help improve their teaching techniques. According to Baleni (2015) and Febriani & Abdullah (2018)such a use can encourage student-centered learning by getting students involved in meaningful learning activities.

In terms of assessment, Timmis et al. (2016)highlight eight distinct areas of opportunity that current digital technologies can innovate student-learning assessment as follows: (i) New forms of representing knowledge and skills, (ii) Crowd-sourcing and decision-making opportunities in assessment, (iii) Increasing flexibility, (iv) Supporting and enhancing digital collaboration, (v) Assessing complex problem-solving skills, (vi) Enhancing feedback to students, (vii) Innovation in recording achievements, and (viii) Exploiting digital learning analytics locally and nationally. Also, based on a systematic review carried out by Kiersey et al. (2018), technology-enhanced assessments in higher education can help bring in the following benefits: (i) Fostering collaborative learning, (ii) Stimulating reflective learning, and (iii) Scaffolding student learning through structured tasks. Although Keirsey's research was focused on tertiary education, the same benefits can be gained by secondary school students.

Different technologies have been employed in student learning evaluation over the past few years, and right now video-based assessments are becoming more and more common (Amin et al., 2021; Lewis et al., 2020; Malisius, 2018; Mat Tahir et al., 2019; Rivera & Heinrich, 2016). This is not surprising given that numerous studies have demonstrated how using video-based assessment tools can help students better understand the ideas they are learning by allowing them to analyse real-world issues and develop and assess novel solutions (Gama & Barroso, 2013; Morgan, 2013). Video-based assessments are strong, high-impact educational approaches that can help increase student learning assessment, as stressed by Rivera & Heinrich (2016). While Mat Tahir et al. (2019) claimed that evaluation through student-created videos is receiving more attention and that his research suggests students have a favourable opinion of this assessment, However, up to this point, the majority of video-based assessments have been used primarily for practical training courses or subjects, such as medical training (Codreanu et al., 2020; Lewis et al., 2020; Súilleabháin & Cronin, 2017; Wiens et al., 2020), to record

students' practical performances or simulations that teachers can access. Students' creation of videos is another way that such assessments can be used (Malisius, 2018; Mat Tahir et al., 2019; Rivera & Heinrich, 2016). It is true that this type of innovative assessment has not been used much in STEM classes or subjects like programming. Because it may be used to assess complicated problem-solving abilities, it is crucial that the usage of student-created video-based assessments be extended to programming courses.

According to the literature, most students find programming to be a challenging subject to understand, which has prompted numerous studies to concentrate on teaching strategies to improve students' comprehension and motivation to learn this subject (Chakraverty & Chakraborty, 2020; Efecan et al., 2020; Huang et al., 2021; Jamilah et al., 2022; Malik & Coldwell-neilson, 2017). Thus far, there have been not many studies that concentrate on programming student learning assessments. In this regard, a review by Chakraverty and Chakraborty (2020) revealed that most programming assessment techniques are based primarily on automated systems that can track and evaluate students' learning performances, such as Drop Project automated assessment tools or systems (Cipriano et al., 2022). Students are typically required to either submit their work assignments to the evaluation systems for review or engage with those systems directly to receive pertinent feedback on whether their works have met the requirements of the assignment. It is obvious that both methods, which let students assess their work based on comments, are essentially the same. A survey of the available literature revealed that there are currently no studies that focus on video-based assessments of student learning in the programming subject.

In the Malaysia's lower secondary school curriculum, a classroom-based assessment has been implemented for all school subjects, including Fundamental Computer Science (Asas Sains Komputer-ASK). Such an assessment has been described as an authentic assessment involving several methods, such as observations, quizzes, tests, and portfolios, which teachers can use as deemed appropriate in their classroom teaching(Kurikulum, 2016). Based on a preliminary study conducted by the current authors involving 27 ASK teachers, who were randomly selected from several schools in several states in Malaysia, only 22 percent indicated that they had used video-based assessments for the ASK subject. Surprisingly, the same respondents indicated that there were no relevant guidelines provided by the relevant ministry and other resources that they could refer to when conducting such an assessment. Apparently, their feedback highlights the lack of guidelines for video-based assessments provided by relevant agencies. It is, therefore, vital for various stakeholders to develop such guidelines to help teachers to implement such a novel assessment in their teaching practices. The same study also revealed that a small minority (14%) of the respondents were not aware that such an assessment could be conducted in their classrooms.

According to the literature, developing a framework for creating videos will generally entail four steps: planning, recording, editing, and publishing (Bārdule,

2021). In theory, a guideline such as this is designed to assist teachers or educators in creating videos for educational purposes only—not for assessment.

In the past, Bergmann & Sams (2012) suggested 11 guidelines for producing educational videos. The guidelines and principles are specifically intended for creating films as instructional materials rather than for use in video-based assessments. Furthermore, neither this principle nor guideline includes the crucial elements that are thought to be pertinent to assessment, such as aligning assessment with learning objectives, technique of problem-solving, and type of evaluation. Against such a backdrop, this research was carried out with the main aim of developing a guideline for assessing student learning in the programming subject based on video.

3. Research Method

This study employed the qualitative methodology to gather information regarding the experiences, opinions, and viewpoints of the respondents in a more detailed fashion (Gläser-Zikuda et al., 2020). Such an approach can offer greater insights into teachers' teaching and students' learning experiences that are difficult to be described quantitatively. According to Golafshani (2003), researchers can use the triangulation technique in a study that involves several investigators or researchers to help validate the research data. As such, this study was carried out in two phases to gather all the relevant information. The first phase involved a series of structured interviews and a literature review, while the second phase involved a focus group discussion involving several relevant subject-matter experts to help develop the guideline. The following sub-sections provide the detailed discussions of the participants, research instruments, data collection methods, and procedures involved in this study. Figure 1 shows the research framework to address the research objectives.

Participants

The purposive sampling method was used in this study to choose the experts and participants. This method, according to Cresswell & Plano (2017), is appropriate for a study involving a population made up of people or groups of people who have particular expertise in or experience with a topic of interest. Interviews were conducted with 10 ASK teachers in the first phase who had used video-based assessment and had more than five years of experience teaching the ASK subject. Due to data saturation at this point, only ten subjects were interviewed during this phase.

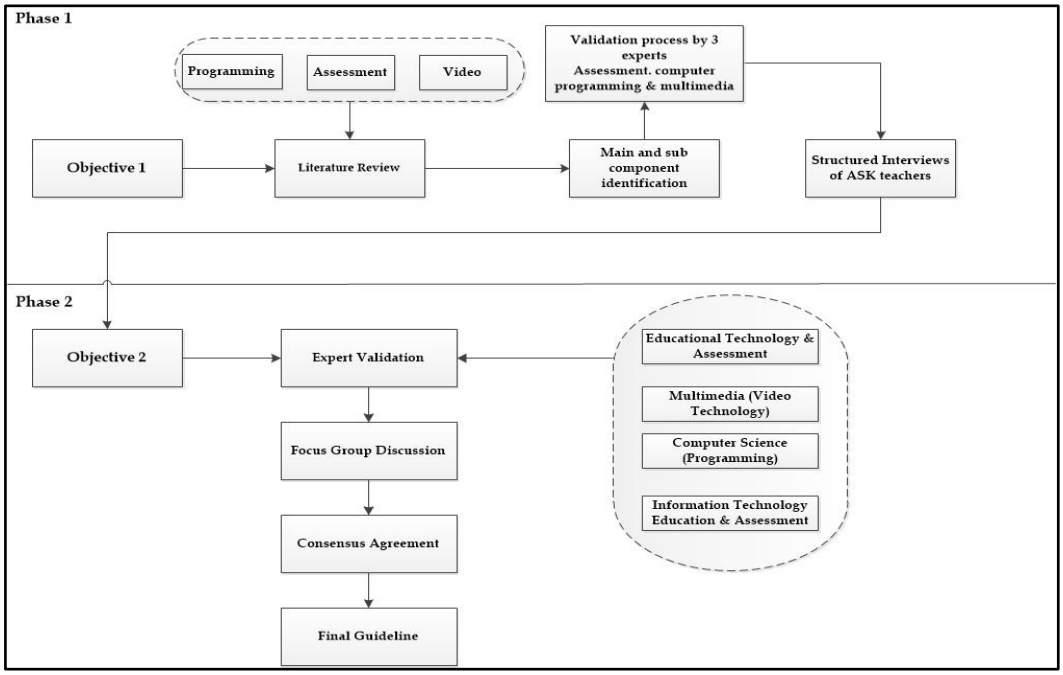

Figure 1: Research framework of the study

A panel of seven experts, made up of lecturers in computer science (programming), multimedia, educational technology and assessment, and information technology education and assessment, was chosen for the second phase. The number of experts in the focus group was deemed adequate because it was between the recommended range of six and eight people for such a study (Mishra, 2016). The experts' demographic profiles are given in Table 1. Except for expert 'E5', who had only six years of working experience as a lecturer, practically all experts had more than ten years of teaching experience.

Table 1: Experts' demographic profiles

Respondent	Designation	Field	Working experience
E1	Associate Professor	Computer Science (Programming)	18
E2	Senior Lecturer	Computer Science (Programming)	15
E3	Senior Lecturer	Educational Technology & Assessment	25
E4	Senior Lecturer/Ex-teacher	Educational Technology & Assessment	20
E5	Senior Lecturer	Multimedia (Video Technology)	6
E6	Lecturer	Multimedia (Video Technology)	15
E7	Expert Teacher	Information Technology Education & Assessment	20

Video-based development components of the proposed guideline

Reviewing the literature on the components and subcomponents of assessment guidelines from various sources, including journal articles, technical reports, and organisational websites, was the first step in the process of generating the implementation guideline. For example, relevant keywords such as "assessment," "formative assessment," "digital assessment," "alternative assessment," "video-based assessment," "video in education," "teaching and learning programming," and "assessment for programming" were used to search the Internet for information on such components. Through this search process, 5 main components and 17 subcomponents were identified for further analysis.

In order to help validate the assessment components of the research instrument for the development of the proposed assessment guideline, a pilot study was conducted with the participation of three experts with extensive experience in computer programming, multimedia, and assessment. The experts offered various recommendations during this pilot study to further enhance the instrument by rearranging the presentation of the assessment subcomponents and their justifications. Likewise, by taking their recommendations into consideration, their professional judgement also assisted in raising the reliability of the research instrument.

Procedure

To guarantee that the data acquired would be reliable and pertinent, it was critical that the focus-group discussions and interviews be conducted in a systematic manner. As a result, the focus-group discussions and interview sessions (which were conducted in the first and second phase of the study, respectively) were carried out based on the recommendations made by Johnson & Christense (2014) and Mishra (2016). The chosen teachers were requested to freely express their professional opinions regarding the relevant elements of the video-based assessment during the structured interviews, which lasted about an hour each. Their spoken responses to the interview questions were recorded and later accurately transcribed.

The focus-group discussion, which lasted around five hours, was facilitated by the researcher in a meeting room. The components and subcomponents of the video-based assessment guideline, which were identified based on the teachers' feedback, were provided to each expert. The moderator opened up the discussion by describing the goal of the study as well as the main and supporting elements of the proposed guideline. The experts responded by giving ideas and recommendations, such as recommending new components or subcomponents that they believed were significant after each component and subcomponent of the guideline had been elaborated in full. As a result of the discussion that took place within the focus group, the explanations or descriptions of all the proposed guideline's subcomponents were revised for clarity.

4. Result

The proposed guideline has 5 main components and 17 subcomponents that were determined using the interviews with the chosen teachers. Table 2 summarizes the main components and their respective subcomponents of the proposed guideline identified through the interviews.

Table 2: Components and subcomponents of the proposed video-based assessment guideline

No.	Main Component	Sub-component
1	Question construction	Topics' learning outcomes
		Problem-solving approaches
		Instruction
2	Video Content	Introduction
		Explanation of problem-solving steps.
		Activity photos
		Conclusion
		Duration
3.	Video Content Presentation	Flow of presentation
		Creativity
		Quality
4.	Technology Requirement	Development tools
		Platforms
5.	Assessment	Self-assessment
		Peer-assessment
		Teacher-based assessment
		Mixed assessment

As was mentioned in the preceding section, the focus-group discussion was held with a panel of experts made up of academicians and instructors to examine in depth the main components and subcomponents of the proposed guideline.

The goal of a focus-group discussion was to extend and clarify the results of data obtained through other approaches, as stressed by Mishra (2016), as well as to produce fresh ideas. The focus-group discussions that were held in this study were essential in confirming the appropriateness of the main components and subcomponents of the proposed guideline. The experts deliberated each major component and its subcomponents during the discussion to make sure the proposed guideline would have all the necessary requirements to guide teachers on how to implement the proposed video-based assessment. As shown in Table 2, there are five main components of the proposed guideline, namely Question Construction, Video Content, Video Content Presentation, Technology Requirement, and Assessment Rubric, which were identified through the interviews. Table 3 shows the finalized main components and subcomponents of the proposed guideline and their explanations.

Table 3: The finalized main components and subcomponents of the proposed guideline and their explanations

Main Component	Sub-component	Explanation
Question Construction	Topical learning outcomes	• The questions should be able to assess the student's learning outcome. • Learning domains can be cognitive, psychomotor, affective, or a combination of the three. • Bloom's taxonomy or any other learning taxonomy should be used to determine learning achievement levels.
	Approach or Method	• The approach or method used to solve a problem.
	Instructions	• Instructions must be clear and precise, including the steps students must take to create video content that includes the following components: (a) Video Components, (b) Video Content Presentation, (c) Technology Requirements.
	Assessment Rubric	• To ensure that students understand the elements that will be assessed, an assessment rubric should be created and distributed to them.
Video Content	Introduction	• Students must provide a brief explanation of how they would respond to the questions and propose solutions.
	Problem-solving Method	• Students must describe each step of a specific problem-solving method used to solve a problem, such as writing pseudo codes, drawing flowcharts, programming, and debugging.
	Activity Photos of Problem-Solving	• As proof of their problem-solving activities, students should provide relevant photographs of systematic problem-solving activities.

	Conclusion	• The knowledge that students have learned through the process of problem-solving must be briefly described.
	Credit	• At the conclusion of the video presentation, students must include some sort of acknowledgement that accords credit to relevant parties.
	Duration	• A video should be between five and seven minutes in length.
Video Content Presentation	Content and flow of presentation	• The contents of the video must be presented in a logical, clear sequence. • The video contents must be relevant to a given problem.
	Presentation Creativity	• To create engaging and entertaining video presentations, students must exercise imagination.
	Communication Element (Verbal and Non-verbal)	• The language used must be suitable and unambiguous. • Live video presentations from the students are required.
	Overall presentation quality	• Presentations as a whole must be delivered with professionalism and clarity.
Technology Requirement	Video development guidelines for students	• Give students a manual outlining the procedures for making videos, either in print or on video.
	Video development tools	• Students can download videos using their own devices, such as smart phones, digital cameras, or tablets, and use presentation software, such as Microsoft PowerPoint, iMovie, or KineMaster.
	Video-uploading platform	• Students should be provided instructions on how to submit videos to various platforms, including Wiki, YouTube, Google Drive, and other social

		media platforms such as Facebook, Instagram, and Twitter.
Assessment Rubric	Teacher-based Assessment	• The teacher can use a specific rubric to assess the students.
	Peer Assessment	• Students may be assessed by their peers using the rubrics provided by their teacher.
	Self-assessment	• Students can grade themselves using a rubric provided by their teacher.
	A mixture of two or more assessment methods.	• Two or more assessment methods can be combined to complete an evaluation.

5. Discussion

The first main component, Question Construction, and its subcomponents were all deemed relevant by the experts. Expert 'E1' argued that in order to make sure that students are aware of the components that will be examined, an evaluation rubric should be presented to them. The other experts agreed with the expert's suggestion to include this as a second subcomponent to the first component. Such a claim is consistent with those made by Amin et al. (2021) and Chowdhury (2019), who caution that inadequate explanations for learning assessments will result in lacklustre performance from students. Students would readily understand the evaluation requirements if they were given a pertinent assessment rubric, which would help them produce high-quality assignments. However, the moderator suggested that the rubric should be included in the last component of the guideline, namely the Assessment Rubric. Meanwhile, expert 'E3' asserted that the questions should be in line with both the taxonomic level of the cognitive domain and the learning outcomes as well. The other experts completely agreed with him, so both criteria were added to the subcomponent of the topical learning outcome as new components. Finally, the experts highlighted the significance of clearly communicating instructions to students so that they would understand how their work would be assessed, as had also been advised by some researchers. (Al-Mahrooqi & Denman, 2018; Amin et al., 2021; Súilleabháin & Cronin, 2017).

When the second component, Video Content, was being discussed, expert 'E4' suggested that one of its subcomponents should be video format. The focus group was nevertheless told by the moderator that this component was already a part of the fourth component, which was the Technological Requirement. In the same discussion, expert 'E5' pushed for the need that students introduce themselves at the start of the video presentation. Given the brief time frame of a video, some of the content experts politely rejected the proposal. After extensive deliberation, it was decided to substitute the student introduction with some form of acknowledgement at the end of the video to provide credit for their contribution. Experts 'E1' and 'E6' made another suggestion for the Video Content component,

pointing out the requirement for supporting materials, like pictures of pupils completing a task, as proof for the subcomponent of problem-solving. Such a suggestion is in line with the claims made in a number of research on video-based teaching and learning (Caratozzolo et al., 2022; Malisius, 2018; Morgan, 2013; Namin et al., 2021)

Expert 'E5' suggested that one of the subcomponents should be video quality, but the other experts disagreed, arguing that the assessment does not specifically focus on video quality. They also asserted that using expensive technology to produce a high-quality video would be out of reach for most students. Similar worries were previously voiced by Al-Mahrooqi & Denman (2018), who stated that it is important to consider students' access to and comfort with technology, especially those who live in developing nations and rural areas, and those who come from lower socio-economic backgrounds.

The other members also determined that self-reflection should be made a subcomponent of conclusion or explanation, notwithstanding expert 'E3' recommendation that it be a subcomponent of video content. There was some dispute among the panellists as to whether the video should be five or seven minutes in length. In this regard, the moderator drew attention to a number of studies that mention video lengths of 6.5-7 minutes (Namin et al., 2021), less than 6 minutes (Brame, 2016), 4 minutes (Malisius, 2018), and 3-5 minutes (Mat Tahir et al., 2019). After careful consideration based on the prior research, all the experts came to the conclusion that the video should be between five and seven minutes in length, arguing that anything less would not be enough for students to produce high-quality videos.

All of the experts concurred that the components listed earlier should be included in the third main component of the guideline, which is the presentation of video content. Furthermore, experts 'E5' and 'E6' argued that in addition to sound and activity photos, students' faces should be included during a video presentation to help improve their confidence and communication skills. Expert 'E3' agreed with them and made a strong case for the need for the video to highlight both students' verbal and non-verbal communication. Apparently, they seemed to agree that the quality of video presentation also relies on students' physical appearance and oral skills, a contention that concurs with that of (Malisius, 2018; Namin et al., 2021).

Given that the content of presentation should be stated clearly in the guidelines and rubric, the name of the subcomponent 'flow' was changed to 'flow and content presentation'. Expert 'E2' also suggested the following description: "The content of problem-solving steps of the problem-solving method that has been learned should be presented orderly". This viewpoint is crucial given that learning programming requires the proper use of appropriate problem-solving techniques (Adila et al., 2020; Jamilah et al., 2022). For the subcomponent "creativity", all the experts eventually came to the conclusion that it would be better for the students to create their presentations based on their creativity, as the assessment would be focused more on the content of the students' answers than on creativity per se. Additionally, they agreed with the subcomponent of this main component, which

is the quality of the video presentation. Finally, they came to the conclusion that the guideline for creativity should be made general.

Technology Requirements, the fourth main component, are broken down into platforms and development tools as its subcomponents. The proposed guideline, according to experts 'E4' and 'E5', should specify the precise kind of hardware and software needs. The remaining experts, however, opposed it, claiming that it would restrict students' freedom to use any software or hardware they have access to. Furthermore, they claimed that it would be impractical to set such requirements because technologies are always evolving. This claim is consistent with de Lange et al. (2020) assertion that when giving students video-based tasks, the technical constraints must be carefully considered. If the hardware and software requirements are not limited, students would have more freedom to use the available technologies. As a compromise, all the experts agreed that general technology requirements would be deemed more practical.

Given that not all students have the essential knowledge or abilities, expert 'E1' recommended in the same discussion that students be given access to a video instruction that demonstrates how to create a video. This recommendation is similar to one of the steps that was taken in the study by Amin et al. (2021)when developing students' video presentation. As a result, the experts suggested adding a new sub-component that would offer instructions in either written or video form for producing videos. The same expert also advised, in addition to such a rule, that students' outstanding videos be displayed; however, the other experts did not agree with this idea, stating that it would be counter-productive.

The Assessment Rubric (Marking System), which is the final main component of the proposed guideline, is composed of four subcomponents: self-assessment, peer-assessment, teacher-based assessment, and mixed assessment. Two experts opposed the inclusion of self-assessment during the discussion of this component, arguing that students would tend to overrate themselves. They were challenged by the other members, claiming that such an assessment would be advantageous because students could objectively evaluate their work based on the assessment criteria listed in the assessment rubrics.

To harmonize the discussion, the moderator pointed out the systematic literature review conducted by (Tumpa et al., 2022a) who found that peer-assessments have been widely investigated, but not self-assessments. Thus, she contended that self-assessments should, therefore, be explored further to understand the dynamics of student learning. As a caution, Tumpa et al., (2022b) assert that peer-assessment should be incorporated in the group assessment process to deter freeloading and bias among students. Finally, after balancing the advantages and disadvantages, all the experts came to the conclusion that self-assessment would be included in the guideline, highlighting the importance of giving teachers the freedom to select the kind of assessment they believe is suitable. In this respect, Amin et al. (2021) underscores the significance of such a rubric and the need for every student to be aware of it while addressing the development of rubrics. Therefore, it was seen reasonable to include this component in the proposed guideline.

In the same discussion, experts 'E5' and 'E6' proposed that students post their videos on social media, with the views and "likes" they accrued being factored into the assessment. These experts reasoned that this would encourage students to produce high-quality videos. However, the other members politely rejected their suggestion, particularly expert 'E7', who stressed that such indications are a gauge of popularity rather than quality. After lengthy deliberation, all the experts agreed that such a suggestion has no strong basis to be included in the guideline.

As previously discussed, the explanations or descriptions of all of the proposed guideline's subcomponents were revised for clarity as a result of the focus group discussion. The various activities carried out helped identify the five main components of the proposed guideline, namely question construction, video content, presentation of video content, technology requirements, and assessment (marking scheme), as well as 21 subcomponents. The detailed descriptions of the subcomponents are shown in Table 3. Teachers can use this novel guideline as an effective tool to assess students' learning performance in the programming subject based on videos that have created.

Interestingly, two of the teachers emphasised some technical aspects of internet accessibility and video quality that students should consider. The researchers agreed that the first component is critical because good internet access is required during the uploading and downloading of documents and videos. As such, teachers must keep this factor in mind when implementing video-based assessments. Because of the students' financial constraints, the experts agreed that video quality would not be considered as a sub-component for the second component.

However, if the students can afford it, the teacher can encourage them to use add-on hardware such as a tripod, drawing tablet, and ring light during the video recording process. Furthermore, one of the teachers fervently advocated for the use of video-based assessments, citing the pervasiveness of novel technologies dominating the current socio-cultural landscape, which has influenced virtually all segments of today's societies, particularly the younger generations.

To establish the effectiveness of the proposed assessment guideline, more research is required. A follow-up study, for example, could be carried out to investigate the extent to which the use of such an assessment guideline can assist programming teachers in accurately assessing their students' level of understanding of the topics covered in programming classes. A similar study can be conducted to assess the levels of acceptance and utilisation of the proposed guideline among teaching practitioners. Clearly, the findings of additional research can provide a better understanding of its effectiveness in guiding programming teachers to assess their students' learning performances.

6. Conclusion

Children of Generation Z and Alpha have grown up with early access to the internet and digital technology. Accordingly, the current assessment methods

used in the education system must be enhanced or supplemented with new, novel assessment methods that are also technologically compatible. This paper provides an insight into a new guideline to assist teachers in effectively assessing student learning of the programming subject or course at the secondary level through video-based creations, which is made up of five main components and twenty-one subcomponents. Particularly interesting, such an assessment method can be extremely useful in emergency situations, such as the outbreaks of dangerous diseases, where conventional assessment methods are ineffective. Arguably, the proposed video-based assessment guideline can be used to assess student learning under any scenarios. To investigate the full impact of this guideline on student learning assessment, more research is therefore required.

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