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Google Classroom: Exploring the Modes and Categories of Technology Use in Instruction According to Web 4.0 and EDU 4.0

Adam L. Miller

Nanzan University, Nagoya, Japan
almiller@nanzan-u.ac.jp

ABSTRACT

The aim of this paper is to explore the boundaries and potential of both EDU 4.0 and Web 4.0, with a particular focus on how advances in the future will influence and alter teaching approaches. The paper begins by examining the history of EDU 4.0 and Web 4.0, as well as what proceeded them; it goes on to list key criteria that can help define these terms. Using Google Classroom as an example, the utilization of both EDU 4.0 and Web 4.0 is examined, and practical applications of various Google Classroom functions are mapped onto the aforementioned criteria. In so doing, it is hoped that both EDU 4.0 and Web 4.0 can be more concretely understood, and that their application in contemporary learning environments can be more easily visualized and appreciated. The findings in this paper are influenced and supported by Klaus Schwab's writings on the Fourth Industrial Revolution, and George Siemens' Connectivism model for online learning.

Keywords: Web 4.0, EDU 4.0, Google Classroom, Instructional Technology, 4IR

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1. Introduction

The aim of this paper is to explore the history of both Web 4.0 and EDU 4.0, as well as each of their prospective predecessors. Not only will it examine how each of these pedagogical strategies have evolved over the years, but the paper will also explore how they are connected with one another. The paper will give details of how contemporary technology and approaches act as a framework to strategically employ self-instructional materials, as well as five central elements, which will be identified and applied to a matrix below.

Not only will the paper give a detailed comparative analysis of Web 4.0 and EDU 4.0, but it will also give examples of online instructional tools that utilize the five previously mentioned elements; the examples will be centered around a free to access online learning platform, namely Google Classroom and the various applications and resources that are associated with it. This study will be supported by the texts of Klaus Schwab (and later Thierry Malleret), who coined the phrase, the Fourth Industrial Revolution (hereon referred to as 4IR), and argue that technology is an unstoppable force that will become ever more present in our lives; while this technology may not be inherently detrimental to society, it must first be understood before it can be applied efficiently and ethically. Another learning model that is central to this text is Connectivism, a framework developed by George Siemens, who has previously applied it to Massive Open Online Courses (hereon referred to as MOOCs). These central texts will be explored further in subsequent sections of this paper.

To further bolster the findings of this paper, the research will also be supported by a number of peer-reviewed papers concerned with EDU 4.0 and Web 4.0, and what their rapid progression may mean for society moving forward; these papers include the 2017 study

conducted by Fernando Almeida, *Concepts and Dimensions of Web 4.0*, which charted a "total of 886 publications" (Almedia, 2017, p.7043) concerned with Web 4.0 and used the Strategic Options Development and Analysis method (hereon referred to as the SODA method), to visually represent the different factors of Web 4.0. *Web 4.0 and New Reformation in Education,* written by Pal and Sarkar in 2021, examine how this contemporary technology can be applied to education, and what influence it may have in the future.

2. EDU 4.0 and Web 4.0 within the Fourth Industrial Revolution

In his 2016 text, *The Fourth Industrial Revolution*, Klaus Schwab described a world that is increasingly influenced by digital technologies, and how this inevitable implementation of technology is both unavoidable and fundamentally unknowable, as the paths these tools will lead us down can be the cause for interesting speculation and discussion, but their true impact can only be truly understood once they have already been introduced to society as "we do not yet know how the transformations driven by this industrial revolution will unfold" (Schwab, 2016, p.2).

Schwab explains that ensuring this technology is implemented to better the lives of everybody is a responsibility that everyone shares, and "all stakeholders of global society - governments, business, academia, and civil society - have a responsibility to work together to better understand the emerging trends" (Schwab, 2016, p.2). Only through understanding the potential this technology holds, as well as the damage it could potentially inflict, can it be utilized in the most effective and ethical manner. Schwab continued this line of thought in the text he co-authored with Thierry Malleret in 2020, *COVID-19: The Great Reset*, which argued that the pandemic acted as a catalyst in bringing about the 4IR, as a plethora of sectors and societies worldwide turned to digital technology to continue a semblance of normality, when social distancing, travel restrictions, and lockdowns were enforced around the globe. The text also briefly explained how tertiary education, which may have dabbled in online education pre-pandemic, was forced to fully embrace e-learning:

> In the pre-pandemic era, most universities refused to offer virtual degrees, fearful that this might dilute their exclusive offering, make some of their faculty redundant and even threaten the very existence of the physical campus. In the post-pandemic era, this will change. Most universities - particularly the expensive ones in the Anglo-Saxon world - will have to alter their business model or go bankrupt because COVID-19 has made it obsolete. (Schwab & Malleret, 2020, p. 203)

Schwab and Malleret go on to explain that e-learning is not simply a replacement for "traditional" face-to-face classes, but a separate entity with inherent benefits. So, they argue, e-learning may be spliced with existing pedagogies, so that the benefits of both approaches could be enjoyed through "blended learning." Simply slotting online learning into the space face-to-face learning once occupied and hoping to retain the status quo may not be readily accepted by students.

> [M]any students would not tolerate paying the same high tuition for virtual education, demanding a reduction in fees [...] In addition, many potential students would question the pertinence of disbursing prohibitive costs for higher education in a world marred by high levels of unemployment. A potential solution could lie in a hybrid model. Universities would then massively expand online education while maintaining an on-campus presence for a different population of students (Schwab & Malleret, 2020, p. 203).

In their most recent text, *The Great Narrative: For a Better Future,* published in 2022, Schwab and Malleret point out that the inequalities that were highlighted during the pandemic are still apparent today, and that technology still has the potential to either enrich or endanger the livelihoods of vast swaths of the global economy. Furthermore, they point to the further saturation of technology in our lives, and that its progression is not slowing in any way, as "[m]ore than 60% of the world's population is now online, compared to 42% in 2015 and less than 8% just 20 years ago" (Schwab & Malleret, 2022, pp. 35-36).

But while the driving force behind digitization is seemingly increasing in power and speed, and the impact that 4IR will have on our daily lives will inevitably be huge, there is little indication that tertiary education has the flexibility or dynamism to adapt to the uncertain world its graduates will be faced with; in fact, some argue that educators are vehemently defending the status quo, and will fight tooth and nail to avoid changing their approach.

> Several authors in the educational change field have observed how profoundly resilient the default culture of schooling is to any attempts to transform it. This resilience persists in spite of key defining features of the default culture being at odds with how children learn best and the teaching practices that most improve student learning (Rincón-Gallardo, 2019, p.54).

It is in this tense climate of facing and resisting change that both education 4.0 (heron referred to as EDU 4.0) and Web 4.0 exist. To further understand the impact Web 4.0 and EDU 4.0 will have on society, it is important to first explore the history of these terms and how they have evolved over time.

3. Web 1.0 to 4.0

Web 1.0 refers to the initial purpose of the internet being a depository of data that users could dip into and retrieve specific information that may be of use to them, meaning that "Web 1.0 was primarily about the consumption of information presented in a hypertext format" (Wu & King, 2016, p.92). The information remained static, and the uploading, updating, or editing of information by users was not a standard feature of Web 1.0.

The term "Web 2.0" was explored by Tim O'Reilly in his 2007 paper, *What is Web 2.0: Design patterns and business models for the next generation of software*. Here O'Reilly used the term to differentiate the contemporary applications of the internet in 2007 to the ways in which it was previously utilized. O'Reilly explained that there is not simply a checklist that qualifies any particular website to become Web 2.0, or if it remains relegated to the Web 1.0 status; instead he put forward the idea of it being a "gravitational core" of malleable qualities, that can lead to a discussion as to how specific corners of the internet approach the technology:

> You can visualize Web 2.0 as a set of principles and practices that tie together a veritable solar system of sites that demonstrate some or all of those principles, at a varying distance from that core (O'Reilly, 2007, pp.18-19).

These principles that O'Reilly refers to include embracing "the power of the web to harness collective intelligence" (O'Reilly, 2007, p. 22), or tapping in to the knowledge of a community to further the collective information available to users; and the more closely a particular site adheres to these principles the more solid its claim to being Web 2.0 becomes.

Web 3.0 looked at using the personal and specific data of individual users and threading them together to build a near infinite data base of raw data that could be used to personalise internet encounters; allowing for an experience tailored to individuals, as well as targeted advertising and services that could greatly reward institutions and corporations worldwide. This paradox

of miniscule and particular information of individuals benefiting global economies meant that academics at the time predicted that "by using semantic and heuristic strategies, Web 3.0 will know you on a very personal level" (Wu & King, 2016, p.92).

The progression from Web 1.0 to Web 3.0 could be summarized as Web 1.0 connected information, Web 2.0 connected people, and Web 3.0 connected knowledge. However, the progression from Web 3.0 to Web 4.0 is arguably more abstract and less clearly defined. Again, the progression is marked by not only the available technologies, but how they are applied and to what end. While Web 3.0 took user information and tailored online experiences to these collected parameters, Web 4.0 uses technology such as big data and Artificial Intelligence (hereon referred to as AI) to "intelligently detect end users intentions and goals and propose them solutions" (Benhaddi, 2017, p.688). This means that the online experience is no longer merely influenced by a user's history or collected data, but these factors can actually end up guiding the users in certain directions that Web 4.0 suggests.

> [W]hile the semantic web or Web 3.0 links semantically the web resources with a descriptive layer, the new Web 4.0 will create a new layer that offers goal orientated links and a set of intelligent operators that connect and transform resources from the functional point of view […] The new smart Web will allow us using smart objects in a smart way in order to lead a smart life in the fields of health, education, business, administration, leisure, etc. (Benhaddi, 2017, p.688).

While Web 4.0 "is still an underground idea in progress" (Aghaei et al, 2012, p.8) it can inspire discussions examining the careful balance between convenience and autonomy, it is perhaps unavoidable that this more influential and pervasive internet experience will become commonplace in every way society interacts with the internet. Much like Schwab and Malleret's insistence that the medium must first be understood before it can be utilized correctly, the boundaries and limitations of Web 4.0 are still being discussed, so the ethical implications of internet interfaces proposing solutions to users are still very much questionable. Such complications could include AI circumventing the need for students to research and write papers (Hern, 2022), or the impact on the service industry as employers measure the merits and demerits of saving money, employing fewer people, and providing questionable customer service (Duy et al, 2020).

4. EDU 1.0 to 4.0

The progression that has led to EDU 4.0 has been similarly fluid, and while the boundaries between each definition are malleable, the evolution can be clearly seen when viewed as a whole. In simple terms, EDU 1.0 refers to the "traditional" approach to education, with an educator transferring knowledge into students, as they engage in learning materials through tactics including memorization and rote learning.

EDU 2.0 emerged alongside Web 1.0, and e-learning became a notable faction of education. But as previously discussed, this information was for retrieval only, and students did not engage in any form of interaction or communication with either their peers or teachers; and approaches relied heavily on "read-only content for online delivery" (Wu & King, 2016, p. 94).

While EDU 2.0 employed new technology, it still relied heavily on the existing approach of students memorizing or mastering a static syllabus. EDU 3.0 also relied on digital technology, but began moving towards a more interactive and knowledge-based education, such as George Siemens Connectivism theory, which saw learning environments not being merely led by a single authority on the subject, but instead influenced and impacted by students, allowing for a far more flexible and evolving learning experience:

> Connectivism is driven by the understanding that decisions are based on rapidly altering foundations. New information is continually being acquired. The ability to draw distinctions between important and unimportant information is vital. The ability to recognize when new information alters the landscape based on decisions made yesterday is also critical (Siemens, 2004).

Here Siemens points to a teaching approach that is constructed in such a way that a lone educator transferring knowledge is no longer the only stakeholder actively influencing the learning environment. Instead, students have the opportunity and potential to inform the curriculum, and this flexible nature allows for courses created under a Connectivism mindset to constantly evolve, improve and remain relevant. This approach was only made possible with a technological base that could handle input from multiple sources, tying it to the Web 2.0, which was no longer static information, and Web 3.0, which allowed for flexibility and dynamism.

EDU 4.0 further embraces contemporary technology, and aims to utilize it to provide a more effective and relevant learning environment. EDU 4.0 takes the tools and technologies that are emerging and applies them to a contemporary and ever-changing learning environment:

> Education 4.0 is a purposeful approach to learning that lines up with the fourth industrial revolution and about transforming the future of education using advanced technology and automation (Suvin, 2020).

That is not to say that the approaches favoured by EDU 1.0 are now no longer employed, however, EDU 4.0 has the potential to adopt all of the approaches that may have worked in the past, and apply them to a framework that is better suited to the contemporary classroom which must equip students with the skills they will need in the digitally-infused society into which they will graduate.

5. EDU 4.0 and its relationship to Web 4.0

In his 2017 paper, Almeida synthesized the findings of 886 papers focusing on Web 4.0, and created a map of 5 key aspects:

1. Symbiotic Web
2. Web of Things
3. Web social computing
4. Pervasive Web
5. Ubiquitous computing

These factors then branched off into more specific examples of Web 4.0's potential utilization. While this study was not focused on EDU 4.0, and did not attempt to apply these findings to an existing learning platform, it is very much a pertinent set of findings, as it helps define a term that is far from universally agreed upon

Taking a step back and looking at both EDU 4.0 and Web 4.0, there are some notable connections that link the two together. Below are just 5 criteria examined above, and how they each relate to both EDU 4.0 and Web 4.0 (see Table 1); these criteria are in relation to both EDU 4.0 and Web 4.0, but it has been designed so that each criterion is thematically connected to its counterpart, showing how closely connected EDU 4.0 and Web 4.0 are.

Table 1.
Criteria of Web 4.0 and EDU 4.0

	Criteria 1	Criteria 2	Criteria 3	Criteria 4	Criteria 5
Web 4.0	AI tools	Predictive user experience	Editable content	Web social computing	Sustainability
EDU 4.0	AI functionality	Flexible student/user experience	Malleable materials	Interaction, edits, and feedback	Sustainability

5.1. Criteria 1

Criteria 1 looks at AI tools and AI functionality in regards to Web 4.0 and EDU 4.0 respectively. As was highlighted by Benhaddi, AI is now synonymous with this technology and can play an influencing role in a number of ways within Web 4.0, such as predicting search inquiries, solving tasks, or answering questions either with a collated data base of information or steering users to relevant online resources. In regards to EDU 4.0, AI applications include grammar and spell checking, but also functionality that can create materials or activities for students.

5.2. Criteria 2

As previously stated, Web 4.0 will be capable of supplying a more refined and tailored experience for users, which will be flexible enough to cater for the needs of individual users. This may include guiding them to particular websites or materials, and constantly evolving and adapting its predictive power, to ensure the experience constantly remains relevant to the users. Within EDU 4.0, students can also expect a much more flexible learning environment, which will adapt to their individual needs. Classes can be held in real-time, or on an on-demand basis for example. Materials can be accessed at any time, and digital resources may be accessed for free, or for cheaper than their tactile counterparts. In short, Web 4.0 and EDU 4.0 will be able "to provide gigantic ubiquitous connectivity and uninterrupted interface between machine and human intelligence" (Pal & Sarkar, 2021, p.68).

5.3. Criteria 3

While not a feature unique to Web 4.0, users have the opportunity to not only edit existing data (on such websites as Wikis), but they can also create their own website or blog, on which they are able to upload and update their own materials. Furthermore, platforms allow for users to upload their materials for the public to access, either free of charge or for a predetermined price. Classroom materials are equally as malleable for EDU 4.0; any updates to curriculums or syllabi can be instantly made, and students can be given access to the most up to date information and guidelines. Materials can also be edited or added by students, again working within the Connectivism model of communal interaction and influence over a learning environment.

5.4. Criteria 4

Web social computing was one of the five central aspects Almeida highlighted when attempting to define Web 4.0; while Web 3.0 (and 2.0 to some extent) relied upon some forms of social computing, this aspect will become ever more central to Web 4.0; social networks, mobile computing and cloud computing are all now synonymous with contemporary online experiences. With increasingly natural language and machine to machine (M2M) communication, artificial intelligence will doubtlessly become more influential in this area as well. Online students can also expect to experience this more technologically driven social

experience; they may get detailed and instantly accessible edits and feedback from their instructors (and peers if they are working within a Connectivism model). This allows for students to apply what they have learnt; instead of being told what they should have done differently on a project they have already submitted; these rolling edits and feedback can ensure the students' work is optimal before it is officially graded. It may also be possible for projects to be checked or graded by AI instructors; the ethical implications of which would need careful consideration and further study.

5.5. Criteria 5

Criteria 5 for both Web 4.0 and EDU 4.0 is sustainability; as previously noted by Schwab and Malleret, the course this technology will take in the future is far from certain, and the demands society will make, and the expectations students may have are difficult to ascertain. Therefore, various tools and digital technologies can work towards future-proofing approaches adopted today; that is not to say there is a definitive plan for how this technology will be applied, or that we have reached the pinnacle of this technology's influence on our lives. However, it could be argued that through the functions of Web 4.0 and EDU 4.0, we can (if utilized correctly) create an environment that could be sustainable for the foreseeable future.

6. Online instructional tools for specific teaching and learning purposes

The various free tools and applications offered by Google are just one example that encapsulates the influence Web 4.0 and EDU 4.0 will have on the global education industry, as well as how said industry will make the necessary alterations Schwab and Malleret alluded to in order to survive in the rapidly changing climate in which we find ourselves. The global pandemic saw a gigantic increase in Google Classroom's user base, leaping from catering to 40 million students to over 150 million in a single year (Lazare, 2021). Google Classroom and a number of other affiliated Google apps helped to ensure the continuation of lessons and courses even when social distancing restrictions meant that face-to-face classes were no longer possible in many countries around the world. While not an extensive list, below are just four examples of Google applications (Google Classroom, Google Meet, Google Forms, and Google Docs) that helped support a different aspect of an optimal learning environment. The difference aspects of these applications will be explored below, and how they interact with the aforementioned criteria explored in Table 1 will also be examined.

7. Google Classroom

This was often used as a landing page for teachers, students and other stakeholders, and all of the subsequent applications that will be mentioned can be accessed through Google Classroom. Putting the synergistic qualities of Google Classroom aside, the platform includes some features that allowed for a semblance of normality for teachers and students during the pandemic, who may have been more accustomed to face-to-face classes. The fact that Google Classroom can be accessed on laptops and desktops, as well as mobile devices such as smartphones and tablets, means that it is accessible for almost anyone with a stable internet connection, helping to improve its accessibility by making it compliant with SCORM (Shareable Content Object Reference Model), as assuring courses can be accessed on a number of platforms is the "de facto industry standard for eLearning interoperability" (scorm.com).

The learning platform is divided into four main sections, Stream, Classwork, People, and Grades (see Figure 1), the functionality of each of which will be briefly explained below.

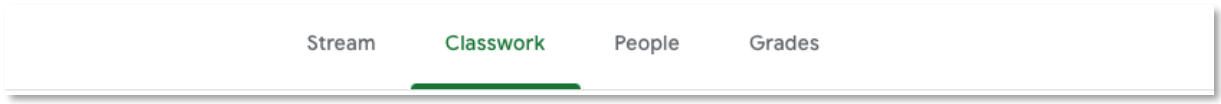


Figure 1. The four main tabs of Google Classroom

7.1. Stream

On this page, stakeholders are able to post comments, materials, or links. The teacher can upload information pertinent to the lessons, or even materials that could be accessed on an on-demand basis. Students can also interact with the teacher, or their classmates directly, allowing them a level of autonomy and the potential to contribute to the learning environment; bringing it more in line with the fluid nature that Seimens alludes to in his writings on Connectivism.

7.2. Classwork

The Classwork tab allows a teacher to assign projects to either individual students or entire classes. These projects can be assigned a grade, which will be automatically collected and added to the overall grade of each enrolled student (which will be further discussed in the following section). The Classwork tab can be used in conjunction with Google Docs and Google Forms, both of which will be explored in greater detail below.

Even after an assignment has been posted, the teacher has the opportunity to edit the project (see Figure 2); they can then add or change a deadline, alter the instructions, the grading system or any other parameters of the assignment. This highlights the flexibility of using online learning platforms.

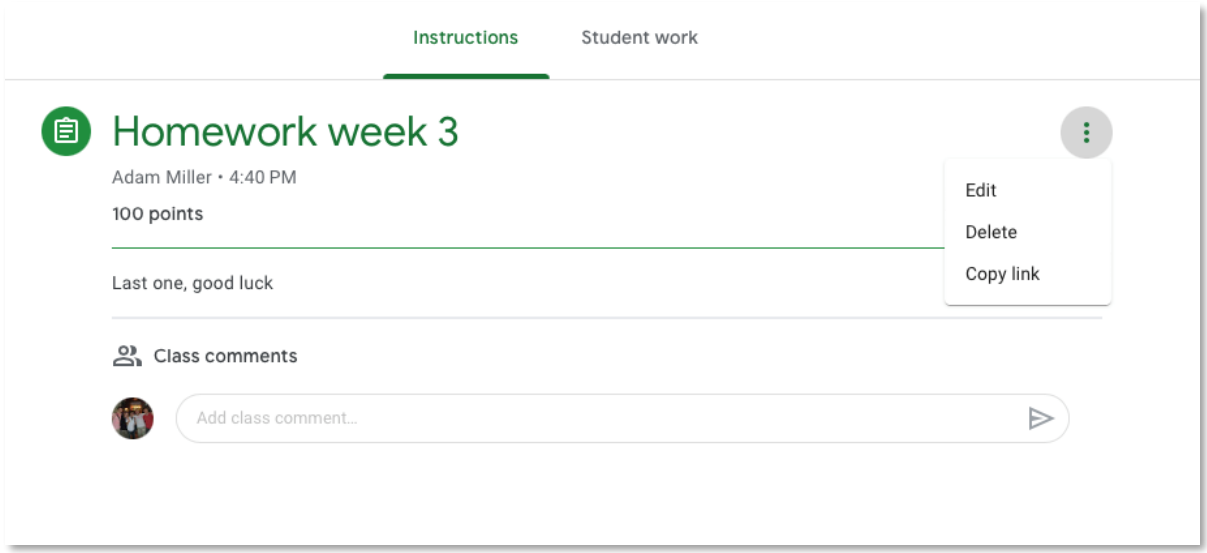


Figure 2. Editability of homework assignments

Once projects have been submitted, teachers are able to view the submission, give a grade (which will be added to the overall grade for the term), and give some feedback to the students (see Figure 3). This page also shows which students have submitted their work, which haven't yet, and if any have missed the deadline. It also separates graded and ungraded projects (note that only one student is in the sample class).

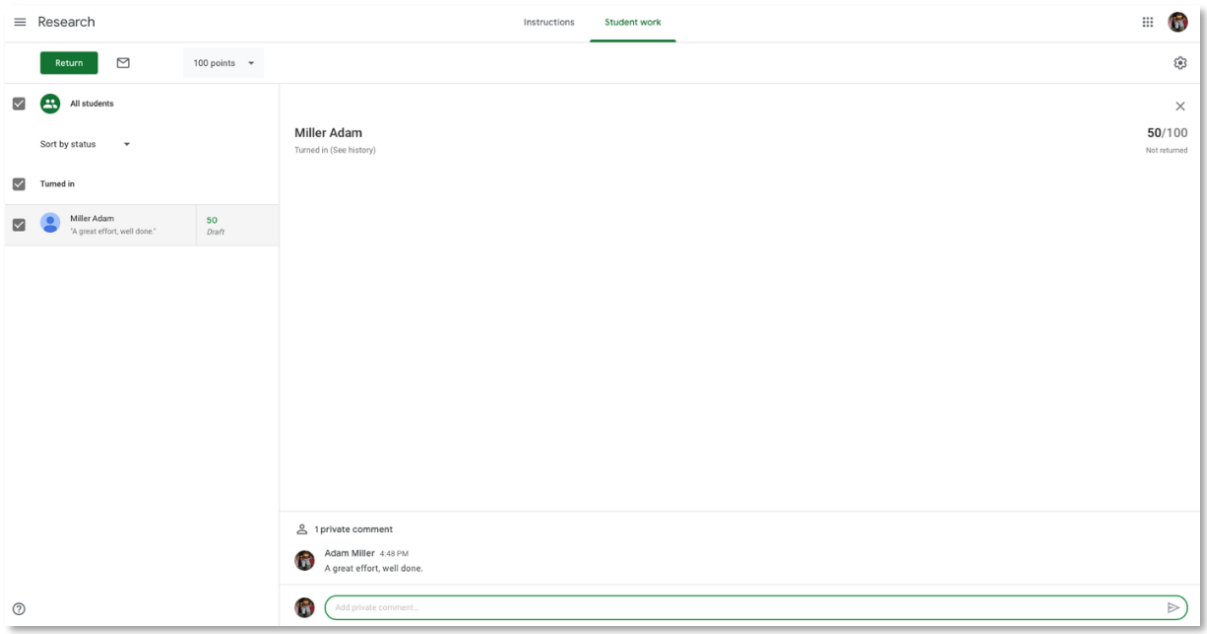


Figure 3. Returning students' work

For students, they interact with the Classwork tab in a similar but fundamentally different way (see Figure 4), as they will not be able to edit the assignments. Students will be able to see all the assignments, any of which they can select to see the description, grading and deadline. After completing the task, they can await their grade. Once it is received, they will see not only their final grade, but also any comments the teacher made. The student will also have access to the work they submitted, and if permitted by the teacher, they can edit and resubmit their work (and potentially improve their grades). This too shows the flexibility of Google Classroom, and how graded projects need not be static, and can instead give the students an opportunity to examine or reassess their work, and perhaps improve upon it.

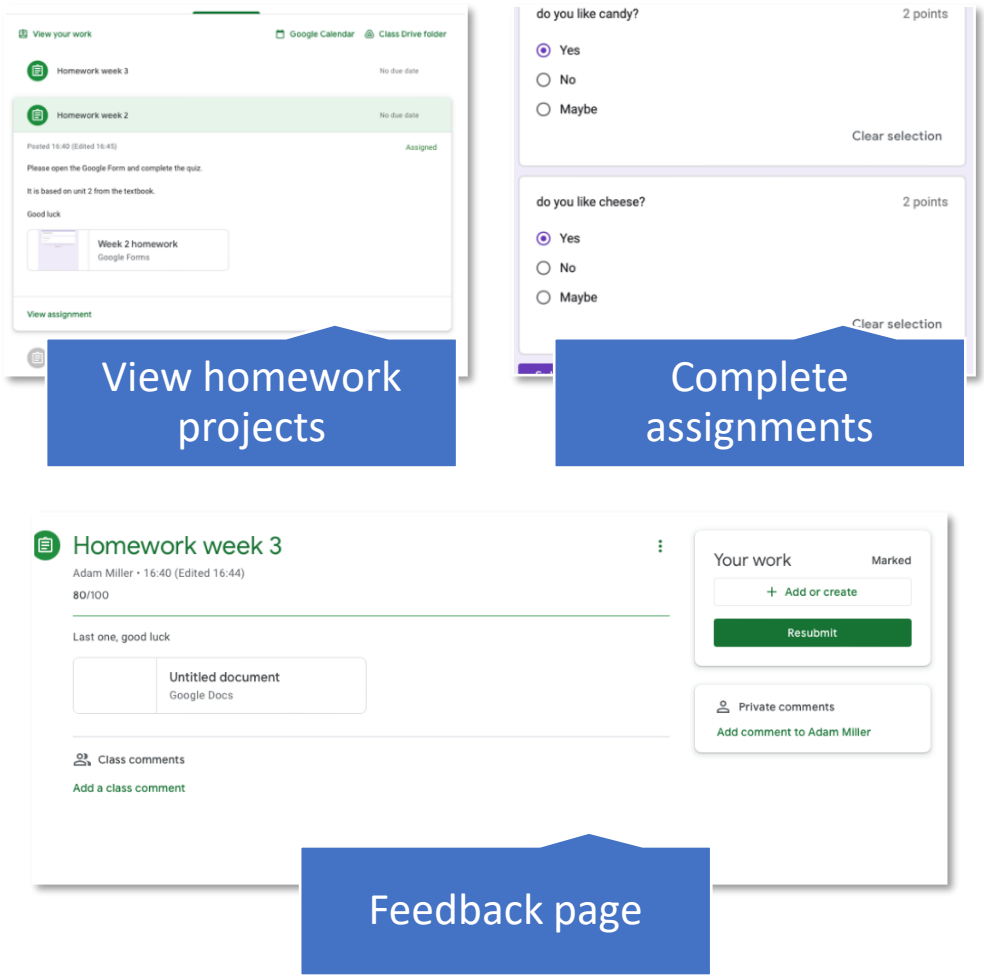


Figure 4. Students' view of Classwork

7.3. People

Here the program lists everyone that is actively engaging with the Google Classroom, and what their role is. Not only does this allow a teacher to have a complete list of the students in their class, it also allows them to sort the students by alphabetical order. By clicking on the three vertical dots adjacent to the students' name, the teacher is given the option to contact each student via email if any problems arise, students can also be muted or removed from the classroom altogether. Those assigned the status of "Student" will not be able to post assignments, nor will they have access to the contact details or grades of their fellow classmates (see Figure 5).

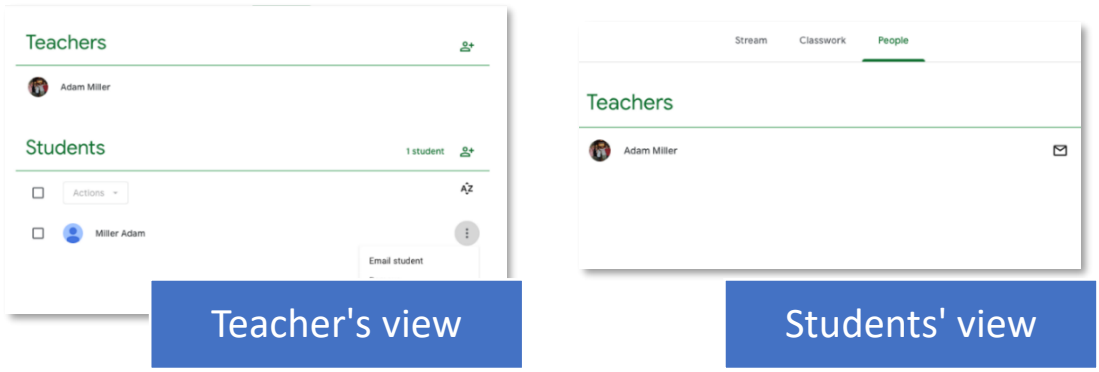
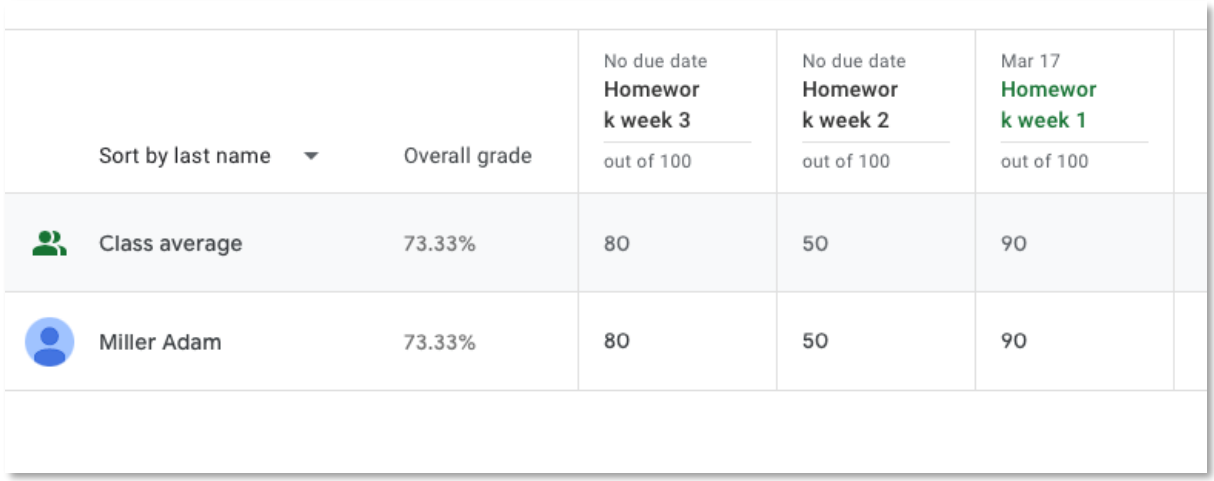


Figure 5. *Google Classroom's "People" tab*

As can be seen from the above figure, the program will offer different functionality depending on the role each stakeholder has within the class. This can help maintain a high level of security, and only those who are granted permission will be able to view or adjust sensitive information that may be found in the class.

7.4. Grades

Here the teacher can be shown the collected grades for each student in the class (see Figure 6). The date of the assignment, title, and grade for each project will be listed for every student in the class. The teacher will also be told if a project was handed in late or not at all. The teacher can also access any individual project by using the "View submission" tool. Grades can also be edited and altered. Finally, the overall grade for each student is displayed as a percentage, which will be compared to an automated class average, making grading much quicker and very accurate.



Sort by last name	Overall grade	No due date Homework week 3 out of 100	No due date Homework week 2 out of 100	Mar 17 Homework week 1 out of 100
Class average	73.33%	80	50	90
Miller Adam	73.33%	80	50	90

Figure 6. An overview of students' grades

8. Google Meet

Google Classroom can be used for on-demand classes, as it has the capability to provide materials that can be downloaded and accessed at the students' leisure. However, Google Meet allows for real-time capabilities as well. This application allows for the teacher to host a real-time video conference, on which students can join, and interact with each other using both their videos and microphones.

Google Meet includes a number of features that a teacher can utilize to enhance the learning environment. Firstly, the conference can be recorded, a video file will then be automatically created and saved to the Teacher's Google Drive. This will allow the teacher to share the recording with the class (they can simply upload the file or a link to the file on the "Stream" tab of Google Classroom), which will allow for students to access the class even if they were unable to attend in real-time.

The teacher can also share their screen, allowing the students to observe what is on the teacher's device. This could simply allow for teaching materials, such as a slideshow, to be shared with the students, or a teacher could use this feature to give a live example of the practical application of a particular task; for example, a teacher could talk their students through the usage of a particular software program as they are using it. Furthermore, the teacher can also allow for students to share their own screens, giving them the same opportunity to interact with their classmates, again improving their autonomy and levels of interaction.

9. Google Forms

Google Forms can be used in a number of ways, but only 2 methods will be explored here; collecting feedback from students and assigning self-grading projects. To the first point, Google Forms can be used to collect data from students, allowing them to give feedback about the course, the materials, or any other variable the teacher may be inclined to adapt. Students can give feedback in the form of short sentences or longer paragraphs, allowing for the collection of qualitative data. Multiple choice questions, checkboxes or Likert scales can also be employed to collect quantitative data; Google Forms can automatically visualize this data in the form of charts and graphs.

In regards to projects, these same tools can be used to create a quiz that will automatically grade the students' work. After creating the Google Form, by accessing the "Settings" tab the teacher can select the "Make this a quiz" option (see Figure 7); this will allow the teacher to create questions and assign them a grade.

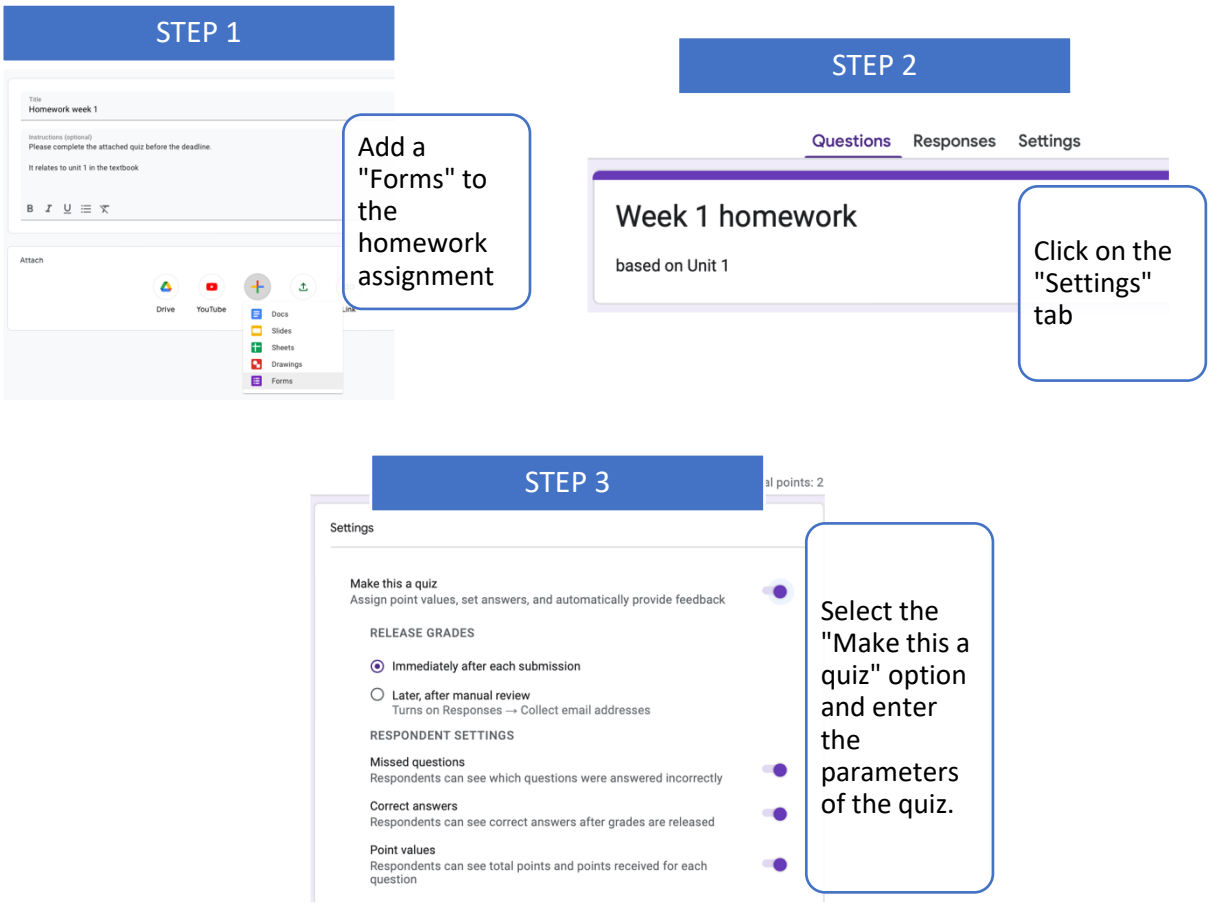


Figure 7. Turning a Google Forms into a quiz

The teacher can then select which options are correct and which are incorrect, and the students' mark will be dependent on how many questions they answered correctly, and the point(s) each question was assigned by the teacher. While the preparation time may be tiresome for some teachers, it removes the need to check and grade each individual submission.

Alternatively, a quiz can be created from the outset, which can make the creation of the materials that much easier (see Figure 8).

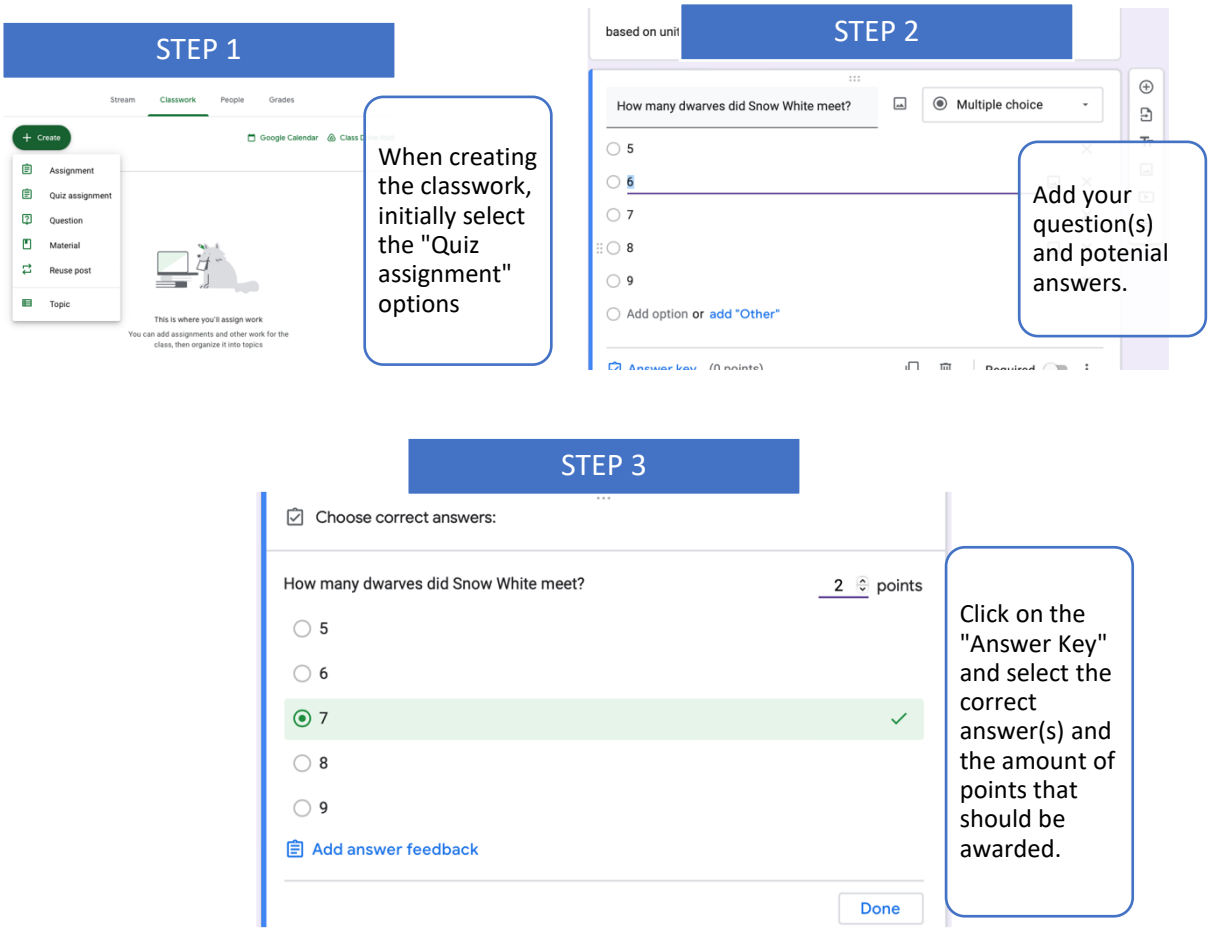


Figure 8. Functionality of Google Forms

The above example is for a multiple-choice quiz, but a number of different options are available, such as checkboxes, dropdown menus, multiple choice grids etc. This should give the instructor even more flexibility in regards to how they want their students to engage with the quiz. Furthermore, visuals and materials can be uploaded to each individual question, further expanding the parameters within which the quiz can function.

10. Google Docs

Google Docs allows for the creation of a document that can be shared and edited instantly. This means that a student can share a document with their teacher, who can then make edits to the work, which will be brought into effect in real-time. Furthermore, teachers can make "Suggested Edits" which the student can then read, review and then decide if they agree or disagree with said edit. This fluid nature of Google Docs means that students can see the effect these suggested edits have on their work in a tangible way, which is more immediate than a physical paper being scrawled on with red ink by a teacher.

Furthermore, in keeping with the tenets of Connectivism, documents can be shared amongst students, who can use the same tools described above, i.e. instant edits and suggestions. This can allow for a single document to be created, edited and completed by a group of students, and their work can evolve and change over time. An inherent benefit of the file being shared amongst students means that no one student has sole responsibility over it, so (in theory) the burden is shared; not only does this encourage a sense of equal ownership amongst the group, it also has the practical advantage of the document not being lost or forgotten, as any student has the ability to access or submit the work.

11. Overall benefits of Google applications

Google Classroom and its connected software have been designed to be intuitive to both students and teachers, so that courses can be easily designed, and equally easy to access. One concern may well be that the lack of face-to-face interaction equates to a loss of community or interaction, but as has been discussed above, the technology does not necessarily hinder the communal spirit, and indeed "[p]articipation and creativity not available in conventional classes are commonplace in well-designed online environments" (Dempsey & Eck, 2018, p.232). These applications and functions are mapped to the previously stated criteria of EDU 4.0 and Web 4.0.

11.1. Criteria 1

AI tools and functionality are present in all 4 of the described applications; for Classroom and Docs, AI tools are used to highlight any spelling or grammatical mistakes, which will be highlighted; a suggested change may also be made by Google (see Figure 9):

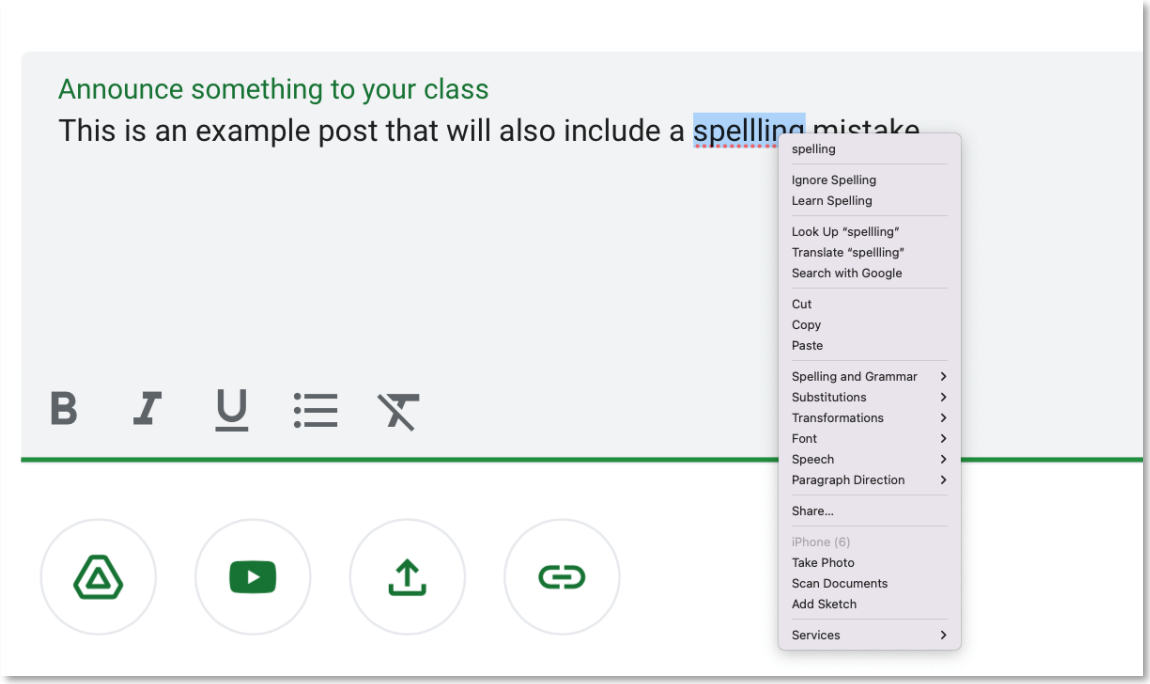


Figure 9. AI assisted tools

In regards to Forms, AI functionality can also be used to find any spelling and grammar mistakes; furthermore, the data that is collected from Forms can be automatically graded, if the purpose of the form is to be a graded quiz. The form could also be designed to collect data, which can then be represented in the form of a spreadsheet (which will be stored on Google Drive and updated as new data is collected), or as graphs and charts, which can visualize the raw data.

Google Meet also has several AI tools, one of which is the automated closed captions that can be used during a meeting; Google Meet will listen to those that are speaking, and will do its best to create captions, by first identifying the language and then typing out what each person is saying. If captions are added to recorded video lessons, this can further increase the accessibility of the classes, as they are not only available on an on-demand basis but can also be of assistance to hard of hearing students.

11.2. Criteria 2 and 3

Students can experience a limited interactive experience with Google Forms, insomuch that their teacher will set them a task and they will complete it; while students can flag or comment on a question however, they do not have the permission to edit or alter a Google Form, putting the experience more inline with the aforementioned "read-only" nature of Web 1.0, and the one-way instruction of EDU 1.0. Both Google Classroom and Docs allow for a much more interactive experience; Classroom can act as a public forum, onto which students can post information, links, or multimedia, giving them the potential to assist in the navigation of the learning experience. With Docs, students can see, consider, and discuss suggested edits, which they can then either accept or deny. Furthermore, as Google Docs can be shared amongst multiple people, and edits are seen instantly, there is a strong shared presence. It could therefore be argued that both Google Classroom and Docs are conducive with a Connectivism framework and can encourage a collaborative learning experience.

Google Meet also has some functions that allow for collaboration; of course, students have the opportunity to turn on their microphones and cameras and converse with one another (and their teacher) in real time; a live chat function can also help make this interaction even more inclusive. A Whiteboard feature can also be used to create even more opportunities for collaborative learning (see Figure 10).

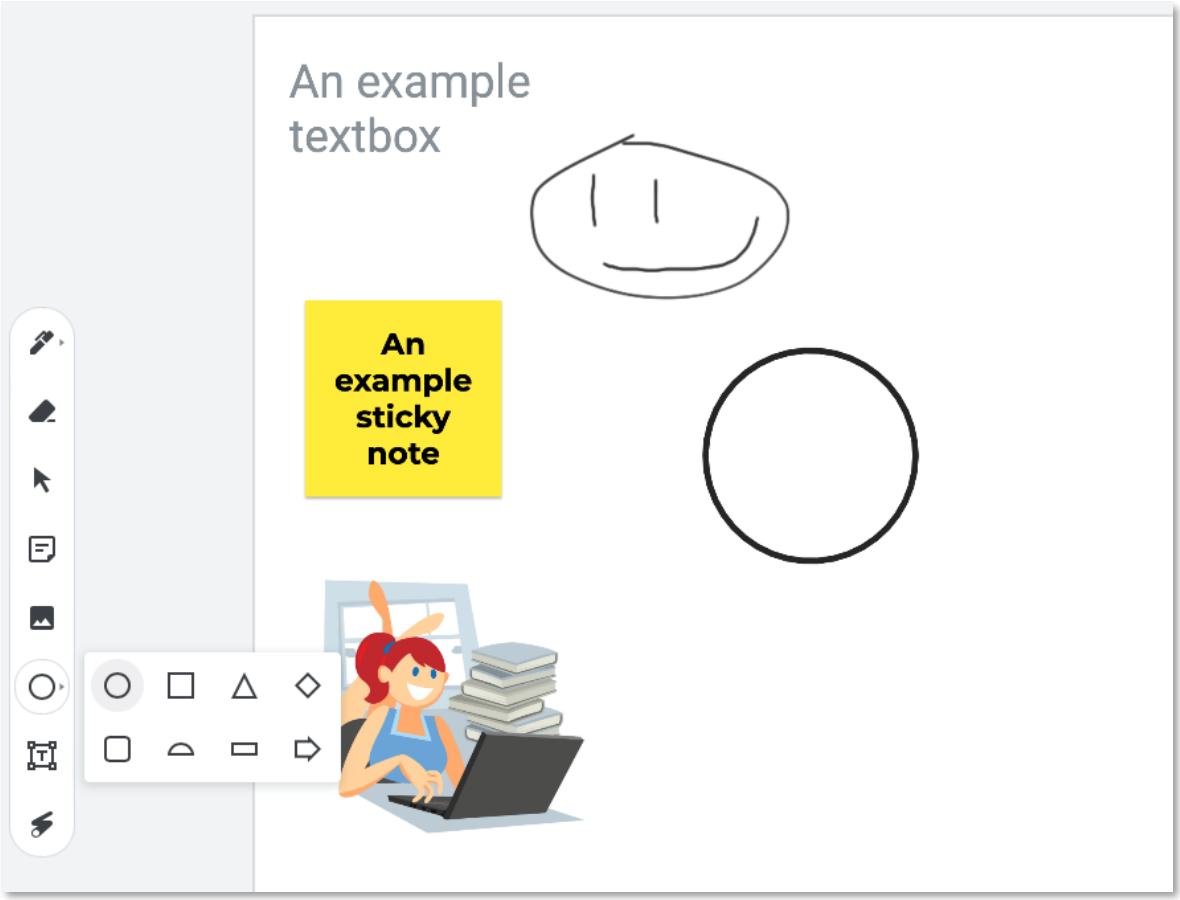


Figure 10: Whiteboard functionality

On the left-hand side of the screen there are several tools that users can select to interact with each other. Starting at the top, the pen tool can be used to draw simple pictures, graphs or even write notes. Underneath there is an eraser tool to delete any mistakes, and then a select tool to help move things around on the board. Underneath there is a sticky note feature, which allows

stakeholders to post a short note; the colour of the notes can be changed, so that students could be assigned a team and grouped by colour for example. Pictures can also be inserted, they can either be uploaded from Google Drive, the user's device, or directly from the Google search engine. Various shapes can also be added, as can textboxes. Finally, at the bottom is a laser pointer, which can be used to highlight specific aspects of the whiteboard.

Much like Google Docs, the whiteboard is instantly updated with edits, so users can interact with each other in real time. This allows for both teacher-led and student-focused activities and has the potential to once again tap into the Connectivism framework.

11.3. Criteria 4

Once rendered and uploaded, the video recording of a Google Meet can be instantly accessible by users, as it will be automatically stored on Google Drive; however, this file cannot be edited or altered without first being imported into a third-party program, such as Adobe Premier Pro or iMovie. Google Forms does have some editability, in that teachers or administrators can update, remove, or add questions; these changes will instantly be made; students will not have this functionality however (unless their "status" within Google Classroom is changed).

Forum posts on Google Classroom can allow for great flexibility; not only can students share posts/materials with each other, but they can also reply to each other, allowing them to ask/answer questions. Furthermore, the teacher can upload digital materials to Google Classroom, which they can update or change at any time, making the classroom materials very flexible when compared to the static nature of a physical textbook.

Google Docs further takes advantage of this flexibility, and all documents can be edited and altered by any stakeholders that have been given permission to engage with it. This could manifest itself in a suggested reading list that is added to throughout a term, or a pool of ideas that the students can constantly dip into, edit, or add to.

11.4. Criteria 5

By adding new applications to their library, many of which are free to access, Google are helping to ensure their sustainability. While the future of EDU 4.0 and Web 4.0 cannot be fully understood, Google's flexibility and accessibility help create an environment that is adaptable enough to face technological advances that may well become central to our daily lives in the future.

Accessibility is assured in two key ways; firstly, as these applications are free (or have a free version), there is a higher likelihood that more users will engage with them, as "even a nominal cost is prohibitive to many" (Veletsianos, 2020, p.145) online users. Secondly, Google offers free tutorials for many of its applications; for example, the tutorial page for Google Classroom (https://edu.google.com/intl/en_ALL/for-educators/product-guides/classroom/?modal_active=none), includes an easy to navigate index, detailed explanations, practical examples, and a video tutorial (see Figure 11), all of which are free and available in a variety of languages.

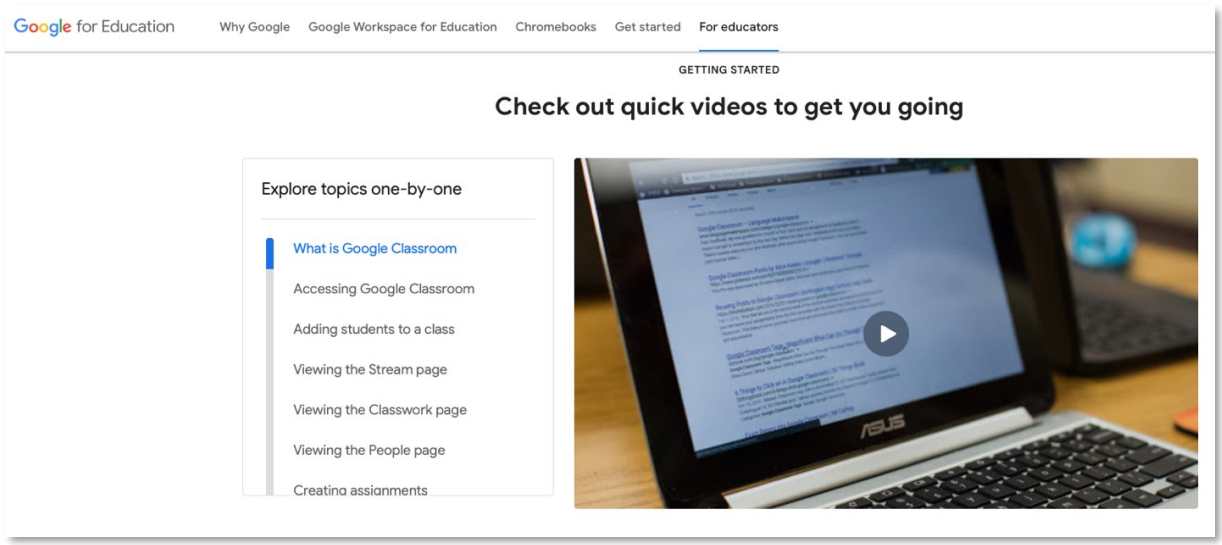


Figure 11: Google Classroom tutorial

While it may be impossible to completely futureproof the library of Google applications, the fact that they are adaptive, often updated, free to access, and are accompanied with free tutorials, all help ensure their sustainability and continued use as Web 4.0 and EDU 4.0 become more prominent in our everyday lives.

12. Conclusion

With the ever-evolving technology that is becoming more and more prevalent in our lives, it is important that educational systems are adaptive and reflective of the environment into which the students will be graduating. Google offers a multitude of applications that are compatible with the demands of Web 4.0 and EDU 4.0, just 4 of which have been explored in this paper. While the true potential of Web 4.0, EDU 4.0 and the 4IR may not be fully comprehended, Google offering a multitude of services that are flexible, interactive, AI assisted, free to use, accessible, and sustainable suggest the company has primed itself to adapt to the uncertain times ahead and take full advantage of the increasingly powerful technology it has at its disposal.

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