Temporary Transitions to Online Problem-based Learning: Advice for Tutors and Learners

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ABSTRACT

We provide a narrative review of the crucial elements for online Problem Based Learning (PBL) and a reflective overview of factors to consider when temporarily moving to online tutorials, forming a practical guide for educators in the health professions and beyond. We give general set-up advice based on the literature and our own recent experience (tutor and learner observational feedback, departmental meeting notes, newly-developed written resources and performance reports) of transitioning between temporary online PBL and face-to-face PBL but note that the majority of this advice translates easily to many types of virtual, interactive tutorial. We also include contextual evidence and theories from existing literature, with a focus on online PBL facilitation, learning and quality assurance. Despite widespread implementation of online teaching, there remain unanswered questions about whether deep learning occurs. The focus of this reflective paper is to better align online PBL practice with the principles of contextual, active, collaborative and self-directed learning and learning issues to be pursued.

Keywords: Interactive platform, Online learning, Resources, Support, Problem based learning

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INTRODUCTION

Problem based learning (PBL) is a well-established and studied pedagogy across many educational domains. This reflective paper considers the evidence for delivering PBL online and suggests practice points for online PBL to align implementation with theories. It focuses on PBL in medical education, but the authors emphasise that many elements can be exploited for collaborative learning in other contexts. Many medical schools have adopted PBL, most offering face-to-face facilitation, but the current Covid-19 pandemic has forced intermittent moves to virtual PBL sessions.

Though PBL online is not a new concept (Savin-Baden & Wilkie, 2006), many course providers, tutors and students have had to make a sudden leap from face-to-face PBL into the virtual environment. Social distancing requirements during the Covid-19 pandemic have propelled us all into accepting blended learning as a new norm arising from immediate necessity. We acknowledge variation in stakeholder skill-sets and confidence levels (Honicke & Broadbent, 2016). In this reflective paper we suppose that we should adapt the practice of PBL online to better align it with relevant theory.

We review the evidence relating to PBL practice and suggest how an online format can be modified to optimise the effective delivery of online, interactive PBL. This reflective paper contains three main parts. Part I explains the theories or principles that underpin PBL practice. Part II reviews the literature about online PBL in practice, and accompanying theory-based adaptations. Part III outlines how online PBL can be implemented to incorporate existing theories and research and possible future directions. The suggestions for implementation are based on a narrative approach following a literature review and consensus reached by the authors following analysis of written feedback collected informally from students and tutors and group discussions with tutors.

PART I: AN OVERVIEW OF THE PRINCIPLES OF PBL

We review the key elements of the PBL process in order to highlight which processes we believe should be faithfully adhered to during a switch from face-to-face to online PBL.

Contextual and active learning
PBL begins with a real-life problem. In healthcare education, the problem context is commonly based on a patient visiting a healthcare professional. In other settings for example, it may be a practical engineering, management or design problem to be explored, understood and solved. The theory is that learning is contextual, that is it is easier to learn material in the context of how it will be used, and it promotes the ability to use the information (Schmidt, 1983). Furthermore, the 'messy' nature of a PBL case

encourages students to critically assess information and tasks and requires the integration of knowledge, skills and attitudes, rather than teaching each of these piecemeal (Dolmans, 2019). This is referred to as an active learning pedagogy. PBL is based on constructivist learning principles where activation of prior knowledge is used by learners to construct new knowledge (Barrows, 1984; Hendry, Frommer, & Walker, 1999; Merrill, 1991; Taylor & Hamdy, 2013).

Collaborative learning
Collaborative learning is another integral element of PBL. The students are focused on a common goal of solving the case and their success depends on each other's contributions (Kirschner, Paas, & Kirschner, 2009). PBL involves small group learning (Savin Baden & Wilkie, 2004), with group size typically ranging from 6 to 10 students.

Self-directed learning
PBL is based on the principles of adult learning, which implies the learner is self-directed in their approach (Merriam, 2001). In this situation, the role of the PBL tutor is to provide 'scaffolding' to give structure and support to students. This involves asking questions to prompt deep learning and managing group dynamics whilst allowing self-directed learning to take place (Doherty, Mc Keague, Harney, Browne, & McGrath, 2018).

In practice, these essential elements are incorporated into a structured tutorial where a case is introduced, students identify relevant information and unknown elements and develop a hypothesis. Further patient information is iteratively reviewed and hypotheses are refined, all the while leading to identification of gaps in knowledge to prompt learning. It is essential that learners are educated in the step-by-step process of PBL (Wood, 2003). Although PBL is widely implemented, there is a risk with a dramatic transition from face to face teaching to online teaching that poor PBL implementation can occur which will not prompt deep learning. In this reflective paper, we consider the evidence for delivering PBL online and suggest practice points for online PBL to align implementation with theories.

PART II: A REVIEW OF THE LITERATURE ABOUT ONLINE PBL

We review the literature describing the implementation of PBL in an online environment. Successful online delivery of PBL is dependent upon the creative use of technology to develop social and cognitive presence. There is large body of research reporting that PBL can be successful and worthwhile in an online environment (Car et al., 2019; Dennis, 2003; Jin & Bridges, 2014; McLinden, McCall, Hinton, & Weston, 2006; Tichon, 2002). However, the literature largely consists of single-site studies and small lessons, rather than significant modifications to curriculum delivery. The qualitative literature suggests

that introducing PBL online is more difficult than many people assume given the changes to routines and processes required (Ardichvili, Page, & Wentling, 2003; Song, Singleton, Hill, & Koh, 2004).

Contextual and active learning online

In a hybrid curriculum model, PBL is used to deliver core concepts and is integrated with other teaching and learning activities (E.g. lectures, practical skills sessions and tutorials). In order to ensure a focused week of study on a PBL case with integrated activities, the timed release of lecture and tutorial materials helps to pace the week for students. As a synchronous learning activity, online PBL provides a valuable opportunity to scaffold students' other learning activities, including self-directed learning, during times of restricted face-to-face interaction (Gaur et al., 2020).

Active learning during face-to-face PBL typically involves the collaborative use of whiteboards to sketch diagrams and take notes. When moving online, these can be drawn on an electronic whiteboards or prepared by the students in advance and uploaded during the session (see examples in Appendix 2). Enabling the sharing and annotating of resources in an online setting is an important group activity as part of the activation and elaboration of prior knowledge that is key to the constructivist process in PBL (Henk G Schmidt, Rotgans, & Yew, 2011) and one that also underlines the student-centered pedagogy of PBL (Koh & Divaharan, 2013; Leng & Gijlers, 2015). During the tutorials, the students can annotate and modify the diagrams, using them to generate and critically discuss learning points.

Taking this a step further, interactive case materials have been designed for the online environment. This could be using digital tools related to authentic professional; scenarios e.g. accessing online drug formulary in healthcare education (Ellis, Goodyear, Brillant, & Prosser, 2008). This has also been implemented where virtual patients describe case information (Savin-Baden et al., 2011) or using real digital information such as patient's x-rays. Often this material is available in-house or free of charge from open-source providers (Bridges, Green, & Botelho, 2015).

Collaborative learning online

The interaction between the tutor, students and task is central to tutorial success and effective management of the socio-emotional well-being of the groups, as well as achieving learning outcomes (Edmunds & Brown, 2010). The tone and time limit of the discussion should be set by the tutor. While experienced tutors may be skilful at managing group dynamics in a classroom, managing an online group can present different challenges. Difficulty engaging reticent or passive students was the most common issue reported by our tutors. Icebreaker activities during the introductory stages can help to create a safe learning environment by encouraging engagement, interaction, teamwork

and relationship building. A variety of online icebreaker activities are available, with most focusing on personal interests and hobbies. Rapport, trust and social presence emerge as students learn about each other (Dixon, Crooks, & Henry, 2006). In preparation for the 2020/2021 academic year we brought students together to work on a group CV/resume. Students' relationship with and perceptions of their facilitator are important factors influencing their learning from PBL (Henk G Schmidt & Moust, 1995) and are, therefore, important to attend to in the online environment. Regular opportunities for informal interaction, such as 'virtual coffee breaks' may help students build relationships with their peers and allow tutors to build social congruence with their groups (Yew & Yong, 2014). This is a key factor in effective facilitation, reducing the sense of distance to enable better critical thinking and depth of discussion (Samy A. Azer, 2009; Chng, Yew, & Schmidt, 2015). Natural inclinations to move / stretch / look around your own environment are acceptable, and better for your health than feeling glued to the screen, with hydration breaks good for concentration.

Perhaps surprising, increasing the use of students' first names when teaching online is a straightforward way that has been shown to increase interactivity and engagement (Evans, Knight, Walker, & Sutherland-Smith, 2020). Ground rules are designed to promote respectful interaction and professional behaviour during tutorials. Using the code for appropriate 'netiquette'(Shea, 1994), we have used this opportunity to develop students' awareness of the concept of digital professionalism (Ellaway, Coral, Topps, & Topps, 2015).

Self-directed learning online
Self-directed learning (SDL) requires students to take the initiative to determine their own learning needs, set goals and strategies to achieve these goals and evaluate their learning. The sharing of learning materials and options such as notes, images, and videos can enhance online learning but also increase ownership of learning and motivation for self-directed learning (Geng, Law, & Niu, 2019). Visual cues are known to complement information obtained from the trigger text and reinforcing new information (S. A. Azer, Peterson, Guerrero, & Edgren, 2012). While motivation is one of the success factors for learning in any context, there is evidence that, for online learners, technology readiness is a determining factor in their engagement with blended learning (Geng et al., 2019). Further research is required to better understand the impact of technology readiness and individual behaviour on academic performance in the context of online PBL.

Learners frequently self-organise virtual activities outside of the online classroom, either purely social or with mixed social and learning purposes. Such supports to self-directed study in the literature were online quizzes (Rossiter, Petrulis, & Biggs, 2010). Some learners draw motivation and morale from their fellow students and will favour these types of activities. Academic advising sessions typically include encouraging peer

engagement. Some institutions have also employed learning analytics to monitor students' online engagement and identify at-risk students (Foster & Siddle, 2020) however, there are concerns that such use of students' data should be guided by ethical practices and policies (Ahern, 2018). This is not something we are currently implementing, but may consider.

Working remotely requires extra effort to engage socially with others online, bridging the distance to create a sense of community and belonging (Chiu, Hsu, & Wang, 2006). Self-directed learners tend to search the online learning platform for resources and research suggests that their perception of collaborative online environments can enhance their self-directed learning (Geng et al., 2019). The literature on social capital and social cognitive learning strongly suggests that the expectations of both the learner and the community will dictate the successful sharing of knowledge online, affecting the formation of learning communities (Chiu et al., 2006).

PART III: AN OUTLINE FOR TRANSITIONING TO TEMPORARY ONLINE PBL

In this section, we describe some of the additional steps, beyond the immediate PBL process, to transition to online PBL delivery. Switching to online PBL is not a simple task and requires technology readiness and educational expertise, staff training, written information for staff and students, troubleshooting, reflection, and fine-tuning.

Establishing a collaborative and inclusive virtual environment with training
Multiple interactive platforms exist for online teaching. Institutions can promote inclusivity and collaboration during online teaching (Downes, 2019) by investing in appropriate technologies and toolkits have been suggested in the literature to help with learning platform selection (Daniela & Rūdolfa, 2019). For online collaboration, use of webcams might be expected to promote effective communication, however, individual choice over the use of platform video function is a contended point. Opinions vary over whether seeing each other enhances engagement or causes distraction (Castelli & Sarvary, 2021). Tutor and learner feedback, provided locally via online meetings and surveys, suggested that being able to see all members of the group enhances the virtual experience, and literature on techniques to encourage the use of cameras is emerging (Castelli & Sarvary, 2021).

The importance of creating a psychologically safe learning environment to promote students' engagement and learning in PBL is recognised (Bate, Hommes, Duvivier, & Taylor, 2013) and must also be a consideration for online learners. Issues such as accessibility to technology at home may be a barrier and students' economic and

geographic contexts should be considered during the planning stage (Erickson, Neilson, O'Halloran, Bruce, & McLaughlin, 2020). In the early days of the pandemic, across Ireland and many countries, existing infrastructure was used to quickly implement online teaching which resulted in some students having appropriate equipment and internet connectivity, whilst others were left poorly prepared (Hall et al., 2020). Since then society has witnessed a massive jump in online teaching skills from teachers and students, heart-warming teamwork and also the provision of devices from libraries and schools. Even in advanced digital economies, connectivity issues prevail for staff and students alike (Besche, Schwartz, & Cockrill, 2021). At our institution, tutors have raised concerns during online PBL meetings about students studying from home in relation to individuals with specialised teaching needs and those working in difficult home situations.

Even though most students and tutors are familiar with IT systems, switching to online tutorials requires the allocation of set-up time to ensure that several basic steps are completed. We recommend the following key measures, based on departmental technical team guidance for tutors and learners:

- Internet connection – users will typically be asked to test internet speed so that the technology team can understand the user system capacity and functionality. Within the institution there are bandwidth limitations. In our case, priority bandwidth was allocated as per our teaching schedule.
- Ensure software is up to date and meets requirements. For example; choice of browser influenced the functioning of the teaching platform, so we asked tutors to install a preferred browser.
- Ensure hardware is in place, installed and functioning (laptops, iPads, webcams, speakers etc.)
- Optimise upload speed. This may require disabling other applications running in the background such as back-up programmes. Also, optimise file sizes for upload by ensuring that resources / tutorial materials are in pdf format where possible and do not exceed acceptable limits)

Comfort with online technologies has been shown to positively impact upon online learning success (Song et al., 2004). Streamlined, quick-reference guides should be created for pre-session training on an online platform. Video demonstrations of platform features and practice sessions with worked examples can help to enrich understanding and assist in troubleshooting queries. Tutor behaviour and facilitation skills are central to the success and effectiveness of tutorials (Boelens, De Wever, Rosseel, Verstraete, & Derese, 2015; De Grave, Dolmans, & Van Der Vleuten, 1999; Doherty et al., 2018) and even very experienced tutors may feel the need to adopt new approaches to preparing for and facilitating online tutorials. Our written preparation advice to tutors, based on challenges encountered and reported within the department, includes:

- Just before your teaching session time, check the connection
- Video communication can feel less fluent and there may be glitches (e.g. blurry picture)
- Inform the students when you are otherwise occupied e.g. uploading a resource
- Make written notes as you would in any other teaching setting
- Be available for one-to-one meetings: Students still have pastoral and academic questions and occasionally still 'arrive early' or stay back for a chat; tutors can verbally acknowledge and facilitate informal query resolution
- Be aware that video communication can also be harder for the students so set an appropriate tone and encourage participation

Good internal communications between tutors, technical and administrative teams and academic staff are essential during online switches. Communicating effectively is important to achieve and maintain global commitment and performance (Saqr, Nouri, Vartiainen, & Malmberg, 2020). We would recommend the following:

- Online training and how-to videos/guides. Technical assistance tailored to the needs of tutors e.g. succinct guides that specifically address relevant online tools and functions avoid extraneous detail found in generic guides.
- Regular group emails to all tutors/faculty with important updates to procedures
- Use of an 'open door' platform (a forum that is accessible and flexible) with dedicated contacts for directed queries. Specific email addresses that are closely monitored can direct tutor queries to the relevant staff and ensure prompt responses to resolve issues.
- Information-sharing and tutor peer support can be facilitated by a social platform (E.g. a WhatsApp group) with clear boundaries for use.

PBL practice online

The practical considerations in delivering PBL online must be made with the aim to promote and support the collaborative, active learning processes that are central to PBL. Decisions about teaching online must also be based on local context: broadband strength, available hardware (webcams, headsets/mics, etc.), time zone differences, the academic calendar, and the turnaround time to make this transition. Using a platform that supports equal access during tutorials for all participants to upload resources, annotate whiteboards and share notes without the need for an appointed moderator reflects the learner-centred approach and student autonomy that is expected for self-directed learning in PBL (Loyens, Magda, & Rikers, 2008).

Having analysed collaborative feedback, we suggest that a platform suitable for PBL should allow:

- a group of up to 12 people to see each other on video camera
- the scribe to take online notes visible by all
- students to post, draw and annotate diagrams
- multiple document uploads for tutorials in various file formats (PDF, JPEG, PowerPoint etc.)

PBL practice online: Roles and Process

It is essential that learners are educated in the step-by-step process of PBL (Wood, 2003). Key aspects of PBL can be explained through an introductory e-learning module. It is imperative that students develop a clear understanding of roles within the online group (reader, scribe, facilitator etc.) and recognise the importance of live participation (Saqr, Fors, & Nouri, 2018). As with face-to-face PBL, "the amount of support required is inversely related to the students' prior learning and understanding of the PBL process" (Davis & Harden, 1999).

PBL practice online: Ground Rules

Ground rules, designed to promote respectful interaction and professional behaviour during tutorials, are central to the PBL ethos. Using the code for appropriate 'netiquette' (Shea, 1994), we have used this opportunity to develop students' awareness of the concept of digital professionalism (Ellaway et al., 2015). The examples below demonstrate ground rules (an unpublished written resource used within our school) agreed amongst our own PBL groups:

- Please join the session using a recommended browser and ensure you are in a quiet space within Wi-Fi range
- To begin at the agreed time, allow 10 minutes beforehand to login
- Please keep your microphone on mute when not speaking
- Keep all other electronic devices at least 2 metres away from the device you are using to connect, this will avoid audio interference
- We are trusting you not to read from any other information sources as you participate
- It is your professional responsibility not to record any of the sessions. Do not make a copy of any institutional resources shown during the session
- Normal attendance rules apply, if you cannot attend for any reason you should inform your tutor/admin contact by email
- You must not write any inappropriate notes / draw doodles on the platform - please keep all contributions strictly relevant

- We must start at the standard time (this was an IT systems requirement in our institution)

PBL practice online: Troubleshooting

Efficient and successful contingency planning relies on the expertise of technical officers working with faculty. Technical officers have an astute overview of technology resources and opportunities. Having selected our preferred online platform, an alternative online platform to teach on was also considered as a backup scenario.

Troubleshooting FAQ documents are useful to address individual access failure / session disruption. We have used WhatsApp to alert tutors to common troubleshooting solutions arising periodically. Over time, we created a forum for tutors to bring up issues requiring technology team support. Most platforms have an option to dial-in via phone to overcome poor laptop microphone audio and 'Hotspots' are a work-around for internet connectivity problems. Uploads sometimes fail if resource files are too large, requiring re-load in a different format. Screen-share tools work as an alternative but short delays can occur. Video clips can be shared but may require a tool in which to input the video-link.

PBL practice online: Progress evaluation

Just as we aim to promote self-regulation and reflective learning in our students, we must also reflect on and evaluate on how a transition to online PBL meets its intended outcomes. Our students complete a regular formative self-assessment on their progress and performance in PBL. They review their assessment and receive individual feedback in one-to-one meetings with their tutors that can also be done securely online.

Collecting student and tutor feedback on the learning environment is essential to improve teaching quality, allow curriculum development, and to rationalise and introduce new practices. There are several frameworks for evaluating blended learning curriculums covering; technical issues, learner issues and service issues, however, no structure has yet emerged as clearly preferred evaluation method (Bowyer & Chambers, 2017). We suggest the following questions for use in a formal evaluation process:

- What devices do you use to study/connect to teaching sessions?
- Has your internet connection made it difficult to access learning material?
- In general, were your instructors confident in using technology to teach?
- Which of the online tools did you most prefer and why?
- Which of the features (e.g. video, chat function, quiz, forum) did you most prefer for communicating and why?
- How easy was it to navigate VLE and find learning material?
- Are all resources (uploads) clearly visible during your sessions?
- Can you access your tutor for 1:1 academic advice and feedback?

- Does anything specific limit the quality of online discussion / how could interaction be improved?

Future directions

In this paper, we found many successful experiences of delivering contextual and collaborative PBL online. The was a scarcity of literature focused on technology readiness to transition to online delivery so Part 3 describes steps to implement PBL in practice. We found tools and practices to encourage collective brainstorming and critical thinking as learners report back on gaps in their knowledge would be welcome similar to Verstegen et al. (Verstegen et al., 2016). How long to allow for the norming and forming stage in online PBL and how often to reshuffle student groupings was something we were unable to find literature on. The interactive tools we describe typically change the interactions and there is some risk that they may take too much attention, becoming a distraction rather than an enabler. Moreover, standardising the resources used by students may also limit the scope of discussion if all students use the same resources. Further research on the impact of these tools on group dynamics and learning outcomes is required. There is some concern that academic advising such as chats directly after a PBL tutorial happen less online and the impact of the change in tutor support is unknown.

CONCLUSION

Successful online tutorial delivery is dependent upon the effective use of technology to develop social and cognitive channels for learning(Carrillo & Flores, 2020). The training and activities described above give practical advice, backed by current evidence, on how to improve the online learning experience. Many of the usual challenges and solutions presented are broadly applicable to collaborative learning beyond the field of medicine, so the authors encourage further discussion and interpretation beyond the healthcare education environment. We refer to how PBL principles can be preserved in translating a traditional ethos to a quality online format, allowing temporary transitions as required. We also explore the challenges that come with using technologies, in the context of a temporary switch to online PBL. User engagement and adaptability, such as student-led creation of resources and 'virtual coffee breaks', were also instrumental in creating an effective temporary switch to interactive online learning.

Declaration of interest

The authors report no conflicts of interest. The authors are responsible for the content and writing of this article.

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APPENDIX 1

Links to two videos of online PBL at the University of Limerick School of Medicine

Video 1: https://www.youtube.com/watch?v=BYgXGZqa9ds
Video 2: https://vimeo.com/412076616

APPENDIX 2

Student-made images for online PBL case (with kind permission of Stephanie Walls, BMBS Year 1, University of Limerick, School of Medicine, 2020).

Students uploaded unlabelled images for annotation using editing tools during online tutorials.
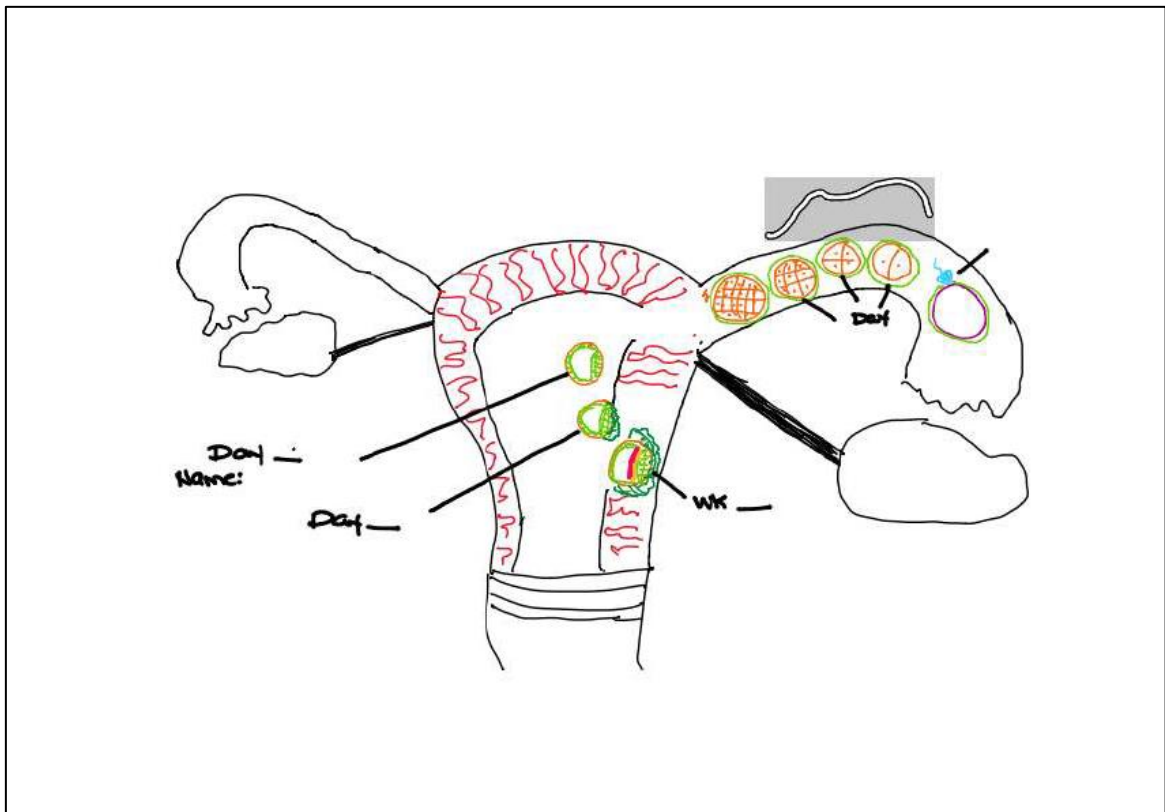

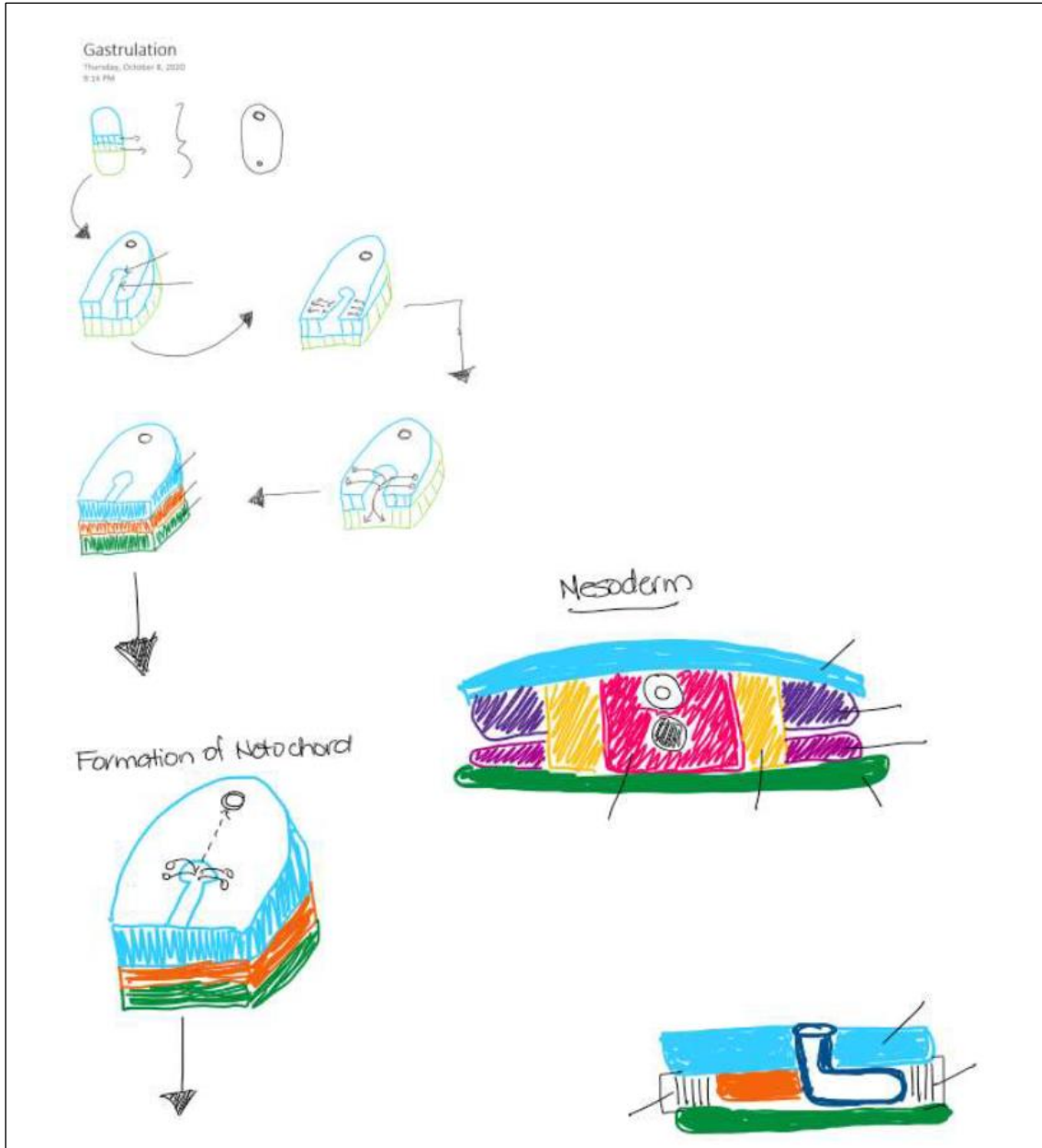*Figure 1. Example of student-made images for online PBL case.*

Figure 2. Example of student-made images for online PBL case.