

*British Educational Research Journal*  
Vol. 46, No. 6, December 2020, pp. 1279–1299

DOI: 10.1002/berj.3632

# How can video-based assignments integrate practical and conceptual knowledge in summative assessment? Student experiences from a longitudinal experiment

Thomas de Lange<sup>a\*</sup>, Anne Møystad<sup>b</sup> and Gerald Torgersen<sup>c</sup>

<sup>a</sup>Department of Education, University of Oslo, Norway; <sup>b</sup>Institute of Clinical Dentistry, University of Oslo, Norway; <sup>c</sup>Faculty of Dentistry, University of Oslo, Norway

This article focuses on how video assignments presenting clinical situations can be implemented in digital summative assessment to enhance the integration of practical and conceptual knowledge. The underlying perspective is that sustainable assessment should comprise evaluative practices that equip students for the challenges they will face in their future professional lives. Drawing on the literature and on empirical results of a qualitative longitudinal research study at a Norwegian university, the integrative potential and challenges of video assignments are examined. The study confirms that video-based assignments are well suited for assessing integrated competencies. However, the complexities of videos' visual displays have clear consequences that indicate how these resources should be produced. To optimise the potential of video use in enhancing sustainable summative assessment, we must strike a balance between technical accommodation, task clarity and integrative potential.

**Keywords:** summative assessment; video assignments; knowledge integration; professional education

## Introduction

The motivation for this article is to study the use of videos for displaying practical procedures and for evaluating performance in summative assessment. The context is a dental exam in oral radiology; the aim is to assess students' knowledge, skills and competence in intra-oral radiographic examination. A major challenge in assessing such competencies is to create an examination setting where students relate to these issues in an integrated manner, that is, where students: (1) observe and consider practical procedures; (2) evaluate the quality of the procedures enacted; and (3) give theoretically and professionally rooted reasons for their considerations in a closely interrelated way. This integration implies that students are assessed not only on theoretical understanding, but also on their ability to engage in practical reasoning and make judgements regarding appropriate clinical procedures. To achieve this synergy,

---

\*Corresponding author. Department of Education, University of Oslo, Karl Johans gate, Oslo, Norway. Email: t.d.lange@iped.uio.no

the implementation of digital summative assessment was seen as a means to develop video-based assignments involving clinical situations to be included in the final examination setting.

The main questions of this study are how the use of video can be applied appropriately in the summative setting and to what extent the complexity of a video introduces unintentional bias into the students' perceptions and processing of the procedural issues. A potential challenge lies in the richness of the visual information presented in a video and the extent to which this richness can contribute to unanticipated difficulties in processing the task at hand. Together with considerations relating to the pressure of the summative-assessment situation, this potential challenge can create confusion rather than directing focused attention. The research questions we seek to answer in this context are:

- How can video-based assignments contribute to assessing integrated competencies in professional education?
- What experiences do students report on the handling of video assignments as part of a digital summative assessment?

The article starts by presenting conceptual perspectives on assessment and knowledge integration in professional education; this is followed by a review of research on assessment in digital settings and also video use. After this, a context description is given. The methods section then describes the longitudinal research design used for developing and implementing the video assignments for the current study. The subsequent section presents the results from a thematic analysis of these experiments over a period of 3 years, leading to a final discussion of the results in relation to previous research.

### **Assessment and knowledge integration**

Within educational course design, the relationships across different knowledge forms have been widely debated (Muller, 2009). An overarching issue pertaining to this discussion involves the relations and constraints between conceptual knowledge (concept and content) and procedural knowledge (competencies, techniques and skills) (Rata, 2019). In professional dental education, the impact of assessment must be taken seriously for several reasons. First, the complexity of bringing together various disciplinary fields, together with the growing complexity of each individual field, is a challenge in itself, and educators and students alike struggle with a volume that is difficult to handle. Discerning how to discriminate and connect across disciplinary boundaries presents an additional set of concerns (Hendricson, 2012). Second, practical and clinical skills must be developed, with the evolving techniques and technologies that are at the heart of the profession to not only be learnt and practised, but also understood and reasoned at a conceptual level (Snyman and Kroon, 2005; Khatami and MacEntee, 2011).

From this perspective, professional knowledge presupposes both conceptual and contextual insights in acquiring the capacity needed to make professionally rooted and responsible decisions. It is this synthesis of conceptual and clinical notions that we refer to as integrated knowledge (de Lange and Nerland, 2018). Integrated

knowledge refers to the entwining of formal and theoretical knowledge, action-oriented knowledge from clinical training and practise, and application of ethical standards inherent within a profession (van Driel *et al.*, 2001; Nerland, 2012). This integration between the practical, the conceptual and value-based standards is vital for the professions delivering healthcare; it is therefore important that this is addressed comprehensively in education and training (Gillis *et al.*, 2015; Brodal, 2016). At the principle level, this integration implies that students should be able to contextualise and rearticulate conceptual notions in relation to concrete practical situations (Mäkitalo, 2012; de Lange and Nerland, 2018). Moreover, they must be able to make knowledge-based decisions that take both practical and theoretical aspects into consideration and foresee the consequences of these decisions.

At the same time, emphasising knowledge integration in teaching and training—a common practice in professional education—commits educators to consider thoroughly how integrative elements can be addressed and underscored in summative assessment. It is in the light of this integrative perspective that ‘authentic assessment’ has entered the assessment debate. Discussions have ensued, in particular, on the means by which generic and practical skills can be combined with disciplinary content in students’ final examinations (Tennant *et al.*, 2010). With respect to digital summative assessment, recent technological developments provide some interesting opportunities for achieving this kind of integration (Damsa *et al.*, 2015; Timmis *et al.*, 2016).

### *Research on digital assessment*

Reviewing the role of digital technology, Timmis *et al.* (2016) point to the need to identify new opportunities for developing assessment practices in education:

The rapid expansion in the available media and modalities that digital technologies offer include text, image, video, audio, data visualisations and haptics (touch). Such new tools provide opportunities for new forms of representation and the use of multiple modalities to demonstrate achievement. They allow assessments to be designed in different forms and allow students to document achievements and progress in a variety of ways and over different timescales.

(Timmis *et al.*, 2016, p. 459)

While underscoring the variety of modalities available for developing different assessment forms, these authors also emphasise the need to experiment with these modalities in order to achieve further enhancement in assessment practices. Recent research has contributed to insights on how technology can be used to engage, shape and influence the way students attain and extend their knowledge (Bloxham and Boyd, 2007; Boud and Falchikov, 2007; Tennant *et al.*, 2010). One of these resources is video technology, a medium that has received increasing attention of late—especially for formative purposes (Deeley, 2018). Within professional health education, several interesting publications illustrate similar findings regarding video-based assessment. A particularly interesting project is the eCAPS-project, which aims to develop an integrated online system with a focus on learning practical skills within a university medical programme (Hay *et al.*, 2013). Comprising several digital elements (online practical skills examples, learner-generated video records of practical skills

and real-time video conferencing), the experiments clearly demonstrate how the creation of authentic learning and assessment situations proves to be effective in supporting integrative approaches as well as addressing summative assessment expectations, thereby preparing students for their exams (Hay *et al.*, 2013).

A similar example from veterinary education reports on student involvement in which the learners created role-plays presenting veterinarian/client consultations (Seddon, 2008). In this study, the author explored the development of links between preclinical and disciplinary content knowledge among veterinary students. In addition to student motivation, one of the most beneficial outcomes of this video-based assessment was the level of self-reflection gained through observation of clinical situations. The findings suggested that this process motivated the students to adopt deep approaches to their learning. Without downplaying the importance of the above-mentioned achievements for student learning, few studies appear to document summative assessment situations in which students' integrated insights, including disciplinary concepts and clinical practice, are tested. Digital experimentation with summative assessment appears to have focused predominantly on reliability, the implementation of digital assessment platforms and digital examination management (Stödberg, 2012, p. 599). Given this tendency, Stödberg's recommendation, which resembles those of Timmis *et al.* (2016) and Hay *et al.* (2013), is to explore more pedagogy-driven approaches to assessment, including the summative perspective. This is particularly relevant in creating opportunities for students to recognise previous learning experiences from teaching and the clinic. This creates coherence between their formative and summative efforts through the integration of practical skills and conceptual knowledge (Whitelock, 2010; Stödberg, 2012).

In this context, it is important to note the concept of sustainable assessment (Boud and Soler, 2016), which concerns assessment practices that 'equip learners for the challenges of learning and practice they will face once their current episode of learning is complete' (Boud and Soler, 2016, p. 401). This focus on preparing learners for future challenges means that clinical and conceptual aspects must become an active part of both formative and summative assessment—in addition to practical and clinical experiences (Boud and Soler, 2016, p. 407). It is with this in mind that we now present our longitudinal analysis of video-based oral radiology exams in which assignments are adapted to integrate clinical and conceptual knowledge (with the aim of preparing students for their forthcoming clinical training and professional practice).

### Context description

The context of the article is an oral radiology course in a dental hygienist bachelor programme situated at a large university in Norway. Oral radiology is a discipline within dentistry that involves diagnostic imaging and the examination of dental structures using radiography. In the context of our study, the teaching of this discipline relates closely to clinical training. It aims to extend the student's autonomy in making clinical decisions and, further, grounding those decisions within a coherent theoretical framework.<sup>1</sup> The oral radiology coursework, which comprises eight ECTS credits,<sup>2</sup> is organised so that teaching, clinical training and practice are integrated throughout the programme in the first and second years; a final summative

examination is conducted at the end of the fourth semester. In addition to this examination, practical competencies are formatively assessed during teaching and clinical training throughout these four semesters (de Lange *et al.*, 2018). The current study is based on observations of students participating in this dental hygienist bachelor programme (as displayed in Table 1).

As seen in Table 1, the fourth semester is the assessment setting for oral radiology, when the experimentation and observation of the video assignments were conducted. The overall structure of this final exam included four thematic sections, where the first section was designed to present video assignments of complex clinical situations, while the other three sections are not covered in this article.

Teaching and feedback activities during the first four semesters prior to this exam also systematically address the above-mentioned integrative knowledge, thereby preparing the students for this type of assignment in their final exam. Preparing students for the video format was specifically addressed in the student-based production of learning videos that focus on clinical procedures with teachers and peers. This activity enabled students to use videos to visually demonstrate and conceptually explain clinical procedures with direct input and feedback from their course teachers as well as from their clinical trainers. Another important teaching and learning activity involved image-interpretation seminars. These started with the student's individual image analysis, which was followed by discussing this analysis with peers, plenary discussions and, finally, teacher feedback. The course teachers also arranged an examination preparation seminar where students went through a mock exam to prepare them for the video assignments.

Table 1. Structure of the dental hygienist bachelor programme

6. semester	TP3200—Public health and clinical specialisation II Final theory and clinic	TP3290 Bachelor thesis
5. semester	TP3100—Public health and clinical specialisation I Thematic weeks, clinic, odontological disciplines, public health, project work, internship	
<b>4. semester</b>	<b>TP2200—Public health and internship II Clinical training, internship, public health, odontological disciplines (oral radiology)</b>	
3. semester	TP2200—Public health and internship II Clinical training, internship, public health, societal dentistry, pharmacology, pathology	
2. semester	TP1200—Introductory dental hygienists II Clinical training, odontological disciplines, public health, project work, preparatory courses, pathology	
1. semester	EXPHIL—General introduction to ethics, history of philosophy and science	TP1200—Introductory dental hygienists II Introduction, preparatory courses, introductory clinic/practical training, public health, odontological disciplines
	10 ECTS	10 ECTS 10 ECTS

The video assignments analysed in this article were tasks that asked the students to *assess and reflect on optimal/non-optimal actions during the performance of a clinical procedure and evaluate image quality and register radiographic findings*. Video footage displaying a specific clinical procedure was integrated into the digital assessment system Inpera assessment ([www.inpera.com/](http://www.inpera.com/)), together with the Safe Exam Browser (SEB) ([www.safeexambrowser.org](http://www.safeexambrowser.org)), which permits the use of text, images, videos and other modalities in exam questions. These objects were incorporated into both the question text and the answer section. An integrated video player was used to show the videos. The students were able to pause the videos and use a scrollbar for quick browsing. They were also able to repeat the videos as often as desired. Figure 1 illustrates the layout of the video within the digital examination platform.

The videos were based on a script provided by the course teachers and were filmed and edited by a professional photographer in collaboration with the teachers. Staff members played the roles of patient and treating hygienist. To protect the staff from radiation, the X-ray units were not activated, so the radiographs shown were obtained from the faculty's patient journal system (patient consent was obtained at the first appointment in the faculty's clinics). These video-based assignments were longitudinally developed; their implementation was observed, evaluated and analysed for further adjustment over a period of 3 years.



Figure 1. Layout of the video within the digital examination platform [Colour figure can be viewed at [wileyonlinelibrary.com](http://wileyonlinelibrary.com)]

## Materials and methods

The study is based on a qualitative longitudinal research design, focusing the empirical investigation on students' perceived expectations and needs in a particular educational setting (Cassell and Johnson, 2006; Silverman, 2013). The overarching aim of the project was to study student experiences and reflections regarding the implementation of digital summative assessment in the given dental hygienist programme, with video assignments representing one of several digital resources.<sup>3</sup> The data extracted in this article thereby draw on findings emerging from student experiences and reflections particularly related to video assignments.

By empirically analysing user experiences from this digital assessment situation, our data provided a starting point for further refinements in future implementations. The researchers involved in this project also require an introduction: while the first author is an external educational researcher with no direct affiliation to the study context, the second and third authors are directly involved in developing the dental programme and in designing the summative assessment. While the former is an external observer and the latter are teachers participating as researchers, all three authors worked together in reshaping the assessment practices of the educational programme (Galuppo *et al.*, 2011).

An important characteristic of qualitative longitudinal research is the temporality of the research design. In our case, this temporality involved the specific use of data and findings to make additional informed changes to the initial intervention. In qualitative research, this especially calls for data on the informants' meaning-making and contextual experiences (Thomason *et al.*, 2003; Hermanowicz, 2016). To capture such experiences, we drew on a variety of data (with student interviews being our main source). Additional data were curricular documents and teaching activities, overviews of student performances in exams, and experiences from video production and redesigns. Overall, a combination of these primary and secondary data provided the grounds for the informed alterations to the video assignments accomplished during the 3-year period of this longitudinal study.

The temporal structure of the project is divided into three main phases. The initial implementation in Phase 1 (2016) was the first time that video-based assignments were used and thereby forms a baseline for the further experiments. Observation of student experiences during this first implementation, their examination results and their experiences 6 months later provided the outline for refinements made for the following student cohort in Phase 2 (2017). This process was repeated in Phase 2, by which time the changes had been implemented; and this formed the basis for the final additional changes made for the third student cohort in Phase 3 (2018). An overview of this temporal design, showing the main empirical data and implemented changes, is presented in Table 2.

To analyse in detail how students approached, handled and experienced the video assignments, we collected interview material from these three student cohorts via plenary discussions conducted immediately after the exam and from a focus group interview 6 months later. The interviews were semi-structured with a relatively broad interview guide framed within the focus of the main project of implementing digital exams. Table 2 provides an overview of informants. The purpose of conducting these

Table 2. Overview of data collection and longitudinal experimental design

Period/phase		Longitudinal experimental design	Empirical data
Preparation phase	December 2015	Student experiences of analogue exam: 6 months after	Focus group interviews ( $n = 4$ )
Phase 1	March 2016	<b>Baseline:</b> Original video-based assignment	Production/testing
	June 2016	Implementation 1st exam	Plenary interviews ( $n = 18$ )
	December 2016	Experiences after 6 months	Focus group interviews ( $n = 8$ )
Phase 2	February 2017	<b>Change 1:</b> Adjustments based on observations and student interviews from Phase 1	Production/testing
	June 2017	Implementation 2nd exam	Plenary interviews ( $n = 19$ )
	December 2017	Experiences after 6 months	Focus group interviews ( $n = 6$ )
Phase 3	March 2018	<b>Change 2:</b> Adjustments based on observations and student interviews from Phase 2	Production/testing
	June 2018	Implementation 3rd exam	Plenary interviews ( $n = 12$ )
	December 2018	Experiences after 6 months	Focus group interviews ( $n = 6$ )

interviews was to capture both immediate perceptions ‘on the spot’ and more reflective understandings and views on these experiences based on stimulated recall.<sup>4</sup>

Analytically, we approached these data by performing inductive thematic analysis (Braun and Clarke, 2006), with plenary sessions and focus group interviews together comprising the main data. In inductive thematic analysis, the first analytic stage of coding is to condense meanings from the data extracts. These codes represent detailed empirical occurrences, which are marked throughout conversational data (Braun and Clarke, 2006, p. 82). In a second stage, codes are studied across the data in order to identify patterns of related meanings. Eventually, these patterns are cross-checked to ensure the identified patterns. The themes identified in our thematic analyses were thus based on matching codes emerging in the interview extracts. These

Table 3. Illustration of themes, codes and quotes from transcriptions

Themes	Codes	Quotes from transcript
Theme 1: Technical accommodation	Utterances referring to technical functionalities related to the video clips	‘Jeg hadde et problem med å spille av filmen først. Det stoppet plutselig’
Theme 2: Task clarity	Utterances referring to task formulations related to the footages	‘Den første videoen var ikke relevant. Man kunne ha svart på spørsmålet uten å ha videoen’
Theme 3: Integrative potential	Utterances referring to conceptual implications related to the footages	‘... man kan reflektere over feil som blir gjort eller ting som kan bli gjort annerledes’



patterns were finally compared to the secondary data to confirm their relevance to the actual examination. Table 3 presents the three main themes emerging related to video assignments, together with examples of how codes were tied to utterances in the data.

The insights gained from this analysis were applied to adjust and further develop the assignment format as a means of better aligning the assessment practice with the curricular goals. Finally, an overarching analysis of all three phases was conducted to establish how the students coped during the different experimental phases.

Permission for conducting this research was granted by the Norwegian Social Science Data Service in 2016, defining clear ethical guidelines to preserve the informants' integrity and anonymity. Informed consent with the opportunity to withdraw from the project at any point of time was obtained from all the informants participating in the study. This also means that all the data extracts are presented with fictitious names.

## Results

The starting point for our analysis, and forming the baseline for further adjustments, is the video assignment in Phase 1, with a focus on optimal and non-optimal performance in a radiographic examination.

---

### *Video-assignment baseline Phase 1:*

- Structure: Video as a continuum (continuous video of patient situation as integrated assignment).
  - Task themes: (1) What influences image quality. (2) How image quality relates to procedures and diagnostics. (3) Risk issues and regulations. (4) Diagnostic assignment.
  - Focus: Optimal **and** non-optimal procedure performance.
  - Displayed procedure: Clinical and radiographic examination.
  - Total video length: 8 min 14 s.
- 

As seen in the description above, this first video assignment presented a continuous patient situation covering several procedural elements in the course of a clinical and radiographic examination. In presenting our results below, three main themes were identified in our analysis which, in turn, informed the adjustments made to the video assignments: (1) technical accommodation; (2) task clarity; and (3) integrative potential.

#### *(1) Technical accommodation*

The theme of technical accommodation concerns comments and discussions on how the technology worked, how the video footage was integrated into the software, how the footage was loaded, opportunities for replay, visibility and so forth. These typical technical aspects surfaced in both the plenary discussions and focus group

conversations. An illustration of this theme from the first phase of the project relates to visual layout and display, which led some students to overlook the video footage entirely.

*Excerpt 1.*

- Anne: The video, I overlooked, we were supposed to write down... yes, that was the video I didn't see. . .
- Marge: You didn't see the written question either?
- Anne: No, I answered the question, but there might have been things I missed because I didn't see it.
- Jane: That could maybe have been a bit clearer.

This conversation from plenary session 1, Phase 1, is one of several accounts from students about viewing the footage. While these students were still able to partially answer questions in the integrated assignment, not having seen the visual procedure somewhat reduced their opportunity to score well on the test. A similar problem occurred when the video footage failed to play on demand and stopped playing for many of the students.

*Excerpt 2.*

- Caren: They [*videos*] stopped alternately, at least with me. . .
- Bren: And it was not possible to rewind either.
- Interviewer: It didn't?
- Daryl: No, you had to watch the whole [*video*] over again.
- Bren: The IT guy told me this happened because it [*the assessment software*] is a closed program which the teachers can't control.

Resulting from a temporary network overload, this problem illustrates the vulnerability of operating within an externally provided assessment software system. Because the external software providers had not prepared for the extensive scale of this kind of assignment, the teachers' and IT supports' hands were tied in handling the problem on the spot. While a bit of technical improvisation saved the situation, this vulnerability was an important eye-opener for the course assessment.

Similar but less serious issues appeared in the data due to problems with the video footage display, which resulted in several time-consuming reruns. Connected to these matters, an important subtheme emerged concerning the students' experience with technical issues:

*... a technical problem, something the programmers rarely consider, I think, is that this kind of mistake is very confusing for us. For me, this was stressful, made me rush through quickly (...) so this was a bit unfortunate.*

For some students, feeling stressed—coupled with minor technical issues such as needing to stop and rewind a video—contributed to their feeling that they were not able to perform adequately. In the analysis, this subtheme of frustration coincided with thoughts about time expenditure and time pressure in the summative examination. Based on these experiences, the technical issues referred to above were resolved

in the last phase of the project. This included an added technical opportunity to stop and rewind the videos, thus giving the students more control over the visual displays in the assignment. Based on these experiences and our thematic analysis, the teachers decided to make the following alterations to the video assignment for the second year.

---

### ***Changes made to video assignment, Phase 2:***

- Non-continuous video (four separate videos).
  - Improved visual layout/visibility.
  - Improved integration (digital platform).
  - Total video length: 6 min, 47 s.
- 

These adjustments were primarily made to provide a technically more viable presentation within the digital summative assessment platform and to improve visibility for students.

The students' experiences with these adjustments bring us to the second theme in our analysis: task clarity.

#### *(2) Task clarity*

Task clarity concerns how well the students were able to perceive the information the videos provided for solving the integrated video assignment. This theme was prevalent in the focus group conversations and in the plenary discussions, and it includes subthemes such as uncertainties about the task and the identification of relevant information. An example of how the informants expressed issues relating to task clarity is illustrated in Excerpt 3, extracted from the plenary discussion after the second exam, in Phase 2.

#### *Excerpt 3.*

- |       |  |
|-------|--|
| Mary: | We could stop and rewind the video in case we wanted to go back and forth to look at it again. However, when they set up for looking very closely, it almost made us think that we needed to go back and forth very thoroughly. I was really confused by that and thought that there was something hidden that I was supposed to discover. |
| Sara: | The focus [ <i>of the assignment</i> ] was on exposure time; that was obvious. But, as has been mentioned, we started looking for mistakes, if it was adjusted correctly or placed in a wrong angle. . .   |
| Mary: | . . . yes, I felt a bit confused by the videos because of that.  |

The confusion described above seems to be created, at least in part, by the opportunity students were given to explore the footage in detail, combined with the possibility of answering without watching the videos. This appeared to create suspicion and confusion, as the partial disconnection between the task and the video was interpreted as a hidden agenda, making the students look for mistakes (i.e. '*you look at the videos, you see other things and you start wondering*' and '*there are so many other things you discover*

when you see the video'). Students described these search efforts as time-consuming and as ending with no additional results. Adding the possibility of stopping and rewinding the videos therefore did not reduce the uncertainty; instead, the students found themselves searching for hidden errors that did not exist. In the focus group interview 6 months later, we examined this issue specifically in order to adjust task clarity in the next phase of the project.

#### Excerpt 4.

- Interviewer: How do you think the use of videos could be improved?  
 Claire: Yes, with more relevant questions.  
 Erika: A clearer relation.  
 Interviewer: More relevant questions?  
 Claire: A clearer connection between questions and videos; for example, what is being done wrong here? What do you need to consider here (*pointing at the video frames*)?  
 Alina: That is what we expected when we learned they were going to use videos on the exam: to find mistakes and write down the correct approach.  
 Erika: I had to watch it several times to understand what the task was about.  
 Interviewer: Is it necessarily a negative thing to look through the videos several times?  
 Erika: No, but I think that, if you quickly understand what it is about and see the connection [*to the questions*], I think this is important when you are in a final exam, so that I know what I am looking for, instead of replaying it several times and not knowing what I am looking for.

As shown in Excerpt 4, the students explicitly identified the need for a clearer connection between the video footage and the questions posed in the task. The relationship between the questions and the visual display was considered vital, so as to avoid confusion and going astray with hypothetical assumptions of possible hidden mistakes.

Reflecting on these findings, it is clear that, for some students, the question formulation resulted in an aimless search for clues and hints that might be hidden in the animation. As this type of search was not related to a specific strategy or disciplinary content, it appears rather pointless in an assessment of the students' knowledge. These findings underscore the importance of investing time and effort in formulating clear tasks that are distinctly observable in the video material. This also holds for potential knowledge elaborations relating to the video assignment. Keeping it relevant by using explicit features in the footage to delve deeper into salient knowledge areas seems here to be the rule of thumb. Equally important, though, is not to lose sight of the main intention of achieving knowledge integration (entailing a connection among theoretical, clinical and ethical elements)—a process that inevitably entails a threshold of complexity. Due to these premises and the insights gained from the empirical data, the course teachers decided to adjust the video assignment in the final phase—first by slicing the videos into smaller sequences, and thereafter reformulating the tasks and questions. By such means, they avoided what potentially could cause unnecessary confusion between textual and visual expression. These adjustments also built on the experiences from Phase 1 and avoided presenting a single, long videotape.

The students' experiences with these adjustments bring us to the third theme: integrative potential.

### (3) *Integrative potential*

The third theme concerns how the students acknowledged the videos as having integrative potential in connecting conceptual and clinical situations in the summative assessment setting. This theme surfaced throughout the project phases. There were several indications of integrative opportunities, but they appeared most frequently in Phase 3 (partly due to the researcher asking the informants more explicitly about this). While the informants in the first two phases paid more attention to the shortcomings in the process, the resolution of these technical issues by the third phase allowed more space for reflection on the integrative potential of video use. Subthemes that emerged in this thematic cluster included the 'relevance of visualising clinical situations' and the 'extent to which this enabled the students to demonstrate their competencies' in ways that were more integrated and conceptually adequate. A characteristic emerging in these themes involved a certain tension and inconsistencies in the data, suggesting a more detailed analysis of the student utterances. Excerpts 5 and 6, in which focus-group participants in the last interview comment on this issue, provide an interesting glimpse into this inconsistent tendency.

#### *Excerpt 5.*

Claire: I see both beneficial and less favourable aspects with the videos. It made me think, 'That's wrong, I would not do that in the clinic' or 'Yes, that's right. I would do that'. It made me think through and become aware of what is good and what is not good practice... based on the videos and what the assignments asked us to consider, and then discuss these issues based on the questions.

As seen in Excerpt 5, Claire comments on how the use of videos triggered her to consider how she would approach a similar situation in the clinic and allowed her to elaborate on these decisions with theoretical explanations and justifications. In contrast, Claire also criticised the videos, referring to '*less favourable aspects*'. A relevant question is what this 'less favourable' might be and to what extent this challenges the justification of using video-based animations of clinical situations to achieve integrative connectedness between theoretical and practical notions in summative assessment. The discussions in Excerpt 6 (following Claire's statement above) might help illuminate this tension more explicitly.

#### *Excerpt 6.*

Eli: There is not really a very big difference between a video or if you are handed a text, it's just that the video illustrates the text, like in this assignment. For example, here (*points to a printout of the video assignment*

- from the exam), they presented a technique, and then they asked questions like this: ‘describe the bisecting angle technique and the...’ So, this is actually the same as asking [*in a text description*] what technique they are applying, just as in the video.
- Irina: But is that really the same? Because with a text, you have already described what it is. And you don’t do that in a video.
- Eli: No, but then [*with a text*] you can use your insight to differentiate between different approaches.
- Irina: But when you see something visually which you have to identify, it is different; this is a different way of presenting a question compared to something written, since the text then exposes [*verbally*] what the case is about.
- Eli: But they could use a picture, then.
- Irina: Yes, but then you can’t really observe how the procedure is enacted.
- Eli: Yes, if you see how the tube is placed.
- Irina: But is a picture then sufficient?
- Berit: No, I do not think so.
- Eli: For me it would have been, I think. Because then you can see what kind of film-holder they use and... .
- Berit: Yes, but think about the clinical situation where they are showing how they place the tube and film-holder in the video.
- Eli: I am thinking about the still picture.
- Sala: But in the video, they also showed how the clinician, on which side she went to put in the, ... then you see everything. A picture only displays the technique, though, without seeing how the person proceeds when putting it in.
- Berit: You can be asked about a lot more when being shown a video compared to a picture. I think a picture is much more contracted. With a video, you can ask about much more and also reflect and analyse.

(Several others in the group agreed with the last utterance.)

In the first part of Excerpt 6, we see how Eli and Irina are discussing the pros and cons of using video in the summative assessment in Phase 3. Eli starts with stating that text, pictures and questions asked in the given video assignment would serve the same purpose as using video to address a clinical scenario. She refers to a specific question from this exam to illustrate her point (*‘Describe the bisecting angle technique...’*) and emphasises that this question is fully manageable without using a video. Irina challenges this position not by addressing this specific descriptive query, but rather pointing at the potential in videos to observe a chain of actions in a clinical situation. Irina further refers to the opportunity to observe and respond more autonomously to video content, in contrast to a textual description, since the former does not contain any descriptive priming of the situation. In the second part of the excerpt, two of the other group participants support Irina’s position. Firstly, Berit confirms a critical question posed by Irina: whether a picture allows addressing the same issues as a video does. Secondly, in the last part of the excerpt, Berit underscores a principal value related to the use of video scenarios, with the opportunity to reflect on clinical practice. Finally, Sala explains the opportunity to scrutinise procedural details on video, which easily escape when presenting textual or pictorial glimpses of a clinical situation.

An important observation from this excerpt is the principal knowledge perspectives on which the above utterances appear to be based. While Eli primarily refers to

descriptive notions of clear-cut questions presented in the assessment setting, Irina, Sala and Berit refer to more compound issues typical of learning a profession (e.g. autonomy, clinical complexities and reflection on the relationship between clinical and disciplinary knowledge). In this sense, Excerpt 6 displays an epistemological distinction in student expectations related to summative assessment as such. A further illustration of this distinction, showing how students disagree on the potential for using video assignments, also surfaces in Excerpt 7.

*Excerpt 7.*

- Berit: Personally, I really liked the assignments.  
 Interviewer: In what way?  
 Berit: I think they allow you to show what you know in a way. . .  
 Alina: Yes, but then you really like to analyse.  
 Berit: That is true.

Berit's statement that video animations are justifiable is explained in the above excerpt by her analytic focus and interest. This reference to disciplinary attentiveness is interesting as far as it confirms the divide illustrated in Excerpt 6, that students approach the assessment situation based on different knowledge perspectives. Interestingly, this divide surfaces throughout all the three data sets, even though it emerges particularly clearly in the last phase.

This recurring pattern of diverging learning and knowledge perspectives emerging in the data is not surprising, and most likely represents a quite typical diversity in prior knowledge and motivation in a student population. This is a clear reminder of course teachers' responsibility to define clear knowledge requirements when using video assignments, while students' input is valuable in understanding how such assignments are approached in different ways.

In summary, the longitudinal results from the analysis presented above resulted in a culmination of successive changes, informed directly and indirectly by student responses as well as by the teachers' and researcher's insights and experiences in making sense of these results in the redesigning process. Table 4 provides a visual overview of these longitudinally generated results.

## Discussion

Referring back to the first research question in the Introduction—How can video-based assignments contribute to assessing integrated competencies in professional education?—our study can provide some illumination. Drawing on the findings above, our data suggest that video tasks are well suited for assessing the kind of integrated competency expected of professional oral radiology clinicians. The videos provide students with opportunities to identify, scrutinise and reflect upon clinical behaviours and decisions and then relate their observations to relevant theoretical perspectives and explanations. Our study also reveals how easily students can go off course when observing videos. Insights from research into more general applications of video, as well as oral radiology, suggest that limitations of perception are

Table 4. Visualisation of longitudinal developments and change

2015—Preparation	2016—Phase 1	2017—Phase 2	2018—Phase 3
Mapping student experiences from programme teaching and exams	<p><b>Baseline:</b></p> <ul style="list-style-type: none"> <li>• Implementing first.</li> <li>• Video-based assignment.</li> <li>• Continuous video of patient situation.</li> <li>• Displayed procedure: clinical and radiographic examination.</li> <li>• Focus: optimal <b>and</b> non-optimal procedure performance.</li> <li>• Video length: 8 min, 14 s.</li> </ul>	<p><b>Change 1:</b></p> <ul style="list-style-type: none"> <li>• Non-continuous video (four separate videos).</li> <li>• Improved visual layout/visibility.</li> <li>• Improved integration (platform).</li> <li>• Video length: 6 min, 47 s.</li> </ul>	<p><b>Change 2:</b></p> <ul style="list-style-type: none"> <li>• Non-continuous video (three separate videos).</li> <li>• Shorter video sequences.</li> <li>• Improved task clarity (more clearly linked to observable behaviour).</li> <li>• Improved integration on digital platform (compared to Phases 1 and 2).</li> <li>• Video length: 1 min, 59 s.</li> </ul>
Dialogue supporting the three themes <sup>a</sup>	<ul style="list-style-type: none"> <li>• Technical: 55%</li> <li>• Task clarity: 23%</li> <li>• Integrative: 22%</li> </ul>	<ul style="list-style-type: none"> <li>• Technical: 17%</li> <li>• Task clarity: 72%</li> <li>• Integrative: 11%</li> </ul>	<ul style="list-style-type: none"> <li>• Technical: 13%</li> <li>• Task clarity: 33%</li> <li>• Integrative: 54%</li> </ul>

<sup>a</sup>It is important to note that the reported frequency in Table 4 only displays utterances relevant to the three themes in the current article. The data sets, in factuality, contain considerably more information about other aspects of the digital exam. As they involved a range of more general issues, they were not considered relevant to our analysis of video assignments.

particularly evident when students are viewing a digital radiographic examination to make a correct diagnosis (Robinson, 1997; Mello-Thoms *et al.*, 2003; Ganesan *et al.*, 2018). In professional practice, limitations of perception not infrequently lead to medical malpractice, which suggests it is plausible to assume the same risks will exist for students watching a video in an exam situation.

Some of the most important viewing strategies in oral radiology involve examining radiographs in a distraction-free environment to minimise competing stimuli, focusing one's attention on only a small area at any specific time and examining the radiographs in a logical and systematic manner to minimise the probability of observer bias (White and Pharoah, 2009). These viewing strategies have been developed to reduce complexity and maintain focus on essential features during observation. This need to reduce complexity is also relevant when implementing video assignments such as those discussed in the current article.

This complexity also emerged in the analysis of developing the video assignment, condensed into the themes of: (1) technical accommodation; (2) task clarity; and (3) integrative potential. An overarching view of the findings presented above reveals how these three thematic aspects presuppose and overlap one another. Technical



issues experienced during the exam seemed to overwhelm students emotionally; this hindered their full appreciation of the integrative potential of this animation resource. It is plausible, therefore, that these uncertainties may lead us to measure student stress management as much as their professional competency, which reminds us of the importance of maintaining focus on pedagogical purposes when integrating technologically driven elements into assessment practices (Stödberg, 2012). Based on these findings, the video assignments were technically improved and better integrated into the digital assessment platform.

Gaining control over the technical issues revealed shortcomings in relating accurate task formulations to the videos. This resulted in adjustments to video length and task formulation so that the content was more directly related to observable clinical actions. Both these factors appear to be important in achieving the project goal of enhancing the opportunity to assess integrated competencies involving practical and conceptual knowledge. Figure 2 illustrates this thematic intersection.

Our findings suggest that, to achieve the integrative potential of video-based assignments, one must carefully consider the correspondence between technical accommodation within the online assessment platform and the development of tasks that clearly relate the videos to the formulated questions. This suggests that we must strike a balance in creating an opportunity for students to resonate within these integrative complexities. Our findings also suggest that failure to achieve such a balance will result in the inability to provide reliable conditions to assess analytic awareness and competencies. With reference to the term *knowledge integration*, these findings imply that contextualising and rearticulating conceptual notions in relation to animated clinical situations is both technically demanding and disciplinarily complex (de Lange and Nerland, 2018).

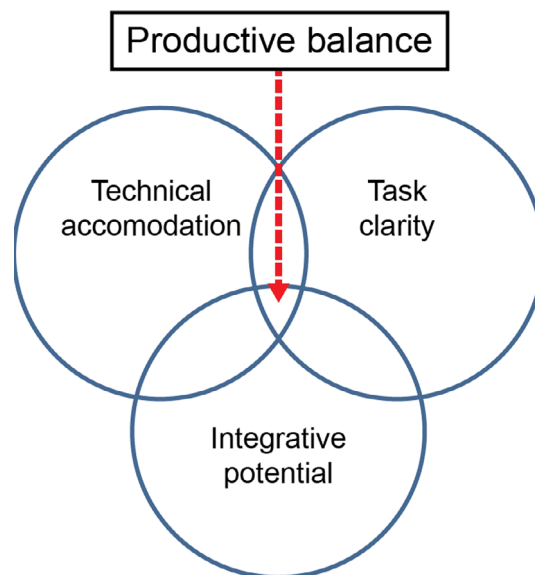


Figure 2. Productive balance in applying video-based assignments according to student experiences [Colour figure can be viewed at [wileyonlinelibrary.com](http://wileyonlinelibrary.com)]

A natural follow-up question is why this integrative focus is so important in this context, and to what end. As previously mentioned, becoming a professional in any field involves much more than acquiring disciplinary knowledge and practical/clinical experience separately. The important question is, therefore: How can we encourage students to develop a capacity to handle complex situations and make appropriate professional decisions in a reflective and reciprocal manner? To achieve this, students should be challenged to respond to a variety of professional situations using conceptual reasoning in final examinations. This not only underscores the priority this integrative dimension holds in developing professional competencies, but could also discourage students from instrumental approaches to learning. Based on our findings, we therefore encourage further experimentation with video-based assignments to explore these opportunities, while noting the importance of achieving a *productive balance* (see Figure 2) when analysing the outcomes of such experiments.

With regard to the second research question of our study—What experiences do students report on the handling of video assignments as part of a digital summative assessment?—several considerations are worth noting. In reflecting on the adjustments made in the last phase of the project, and especially based on our insights into the way students divide epistemic notions, relying on students' experience-based input calls for caution. One of the main aims of implementing a video assignment was to have the students imagine themselves in the clinic, observing and acting on a diagnostic situation or an interaction with a patient, taking the same (or similar) steps they would follow in their daily practice. Responding uncritically to students' perceptions and judgements of video assignments could easily lead to adjustments that contribute to oversimplifications of the exam. The perspectives of student informants, therefore, need to be considered critically, given the risk of not challenging students sufficiently to reflect on their own knowledge perspectives, reflections we consider vital in learning about the profession.

In this light, the last finding from our analysis is particularly interesting in relation to the conception of 'authentic assessment'. If we listen solely to students' critical voices, our goal of integrating generic and practical skills with disciplinary content may be difficult to attain (Tennant *et al.*, 2010), since oversimplification may result in sacrificing authenticity with its inherent complexity. This last point is a reminder of both the limitations of the data in the current study and the responsibility of teachers to define course requirements clearly in relation to assessment, and to set out those expectations in the course syllabus to further enable students' self-reflection. While student input is valuable in understanding the struggles students experience in developing integrated insights—which are important in developing aligned teaching and feedback practices—the study also exemplifies how video demonstrations provide an opportunity to communicate the expectation of attaining such integrated competencies throughout the course.

This expectation corresponds with previously documented findings of students gaining a higher level of self-reflection by using videos to link content knowledge to clinical situations (Seddon, 2008). This integrative feature is essential to the development of professional skills and disciplinary autonomy. Using videos to achieve integration also accommodates Boyle and Hutchison's (2009) notion of e-assessment's potential to open wider knowledge ranges, as well as echoing Hay *et al.*'s (2013)

experience of assessing students' clinical capacity in online environments. The experiment described in our article indicates that video tasks can contribute to extending this reflective knowledge into summative assessment situations, at least for most of the student informants, especially following the improvements implemented in Phases 2 and 3 of our project.

A final remark in this discussion pertains to the issue of sustainable assessment mentioned in the Introduction. By referring to Boud and Soler's (2016) discussion about how to equip learners to meet future challenges, we wish to extend these perspectives based on our own findings. As these authors state: 'For assessment tasks to be considered as sustainable, the whole process of assessment must be conceived of as an active part of curriculum to enable students to achieve particular outcomes, not just as a means of ascertaining whether outcomes have been achieved or not' (p. 407). The use of video in our experiment was specifically aimed at bridging the gap to future learning activities and clinical practice. While this article does not allow us to elaborate on all the efforts made toward this connection, interviewing students 6 months after they viewed the videos gave us a glimpse into the way students continue to pursue knowledge beyond the final exam. In this respect, the whole project is based on a holistic view (Damsa and de Lange, 2019), enabling the exploration of sustainability (and its manifold possibilities) to further enhance future professional capacity.

It is important here to note that a main learning benefit the students refer to in using video scenarios in summative assessment is the opportunity to reflect on clinical practice in a way that combines cognitive and practical insights. On the one hand, reflection can refer to learning about or understanding a practical situation through the lens of conceptual perspectives, while on the other hand, it can also refer to critical reasoning around more open-ended realistic situations with no easy answers. Whilst learning to reason critically is difficult in any professional education programme, introducing video-based assignments containing elements of professional practice may hold a range of interesting opportunities to emphasise this reflective focus in summative assessment.

A challenge noted from our findings is that the use of video assignments is not only technically demanding but also epistemologically complex. This complexity needs to be included in future experiments in ways that elaborate on the range of task opportunities made available in video assignments. A recommendation for future research is to find a balance between assignments aimed at testing integrative knowledge through (1) simplistic steps in a clinical procedure as well as (2) more complex clinical situations. In both instances, it is important to be aware that being overly directive and decontextualising tasks runs the risk of narrowing and simplifying learning into 'bite-sized', 'easily digestible' forms. Future research should also explore the significance of viewing strategies related to video-based assessment and involve students in designing video material that can be used to elaborate further on sustainability from the perspective of lifelong learning.

## **Acknowledgements**

The authors would like to thank the students participating in the interviews as well as dental hygienists Hege Markussen and Aud Jorid Kjellsbøl Hole and photographers

Fredrik Pedersen and Kaja H. Leijon for valuable help with the production of the digital exam. The present research was approved by the Norwegian Social Science Data Service (Project No. 47635) and conducted in compliance with local institutional requirements on research ethics ([www.uio.no/english/for-employees/support/research/ethics/](http://www.uio.no/english/for-employees/support/research/ethics/)).

## NOTES

<sup>1</sup> [www.uio.no/studier/program/tannpleie/oppbygging/](http://www.uio.no/studier/program/tannpleie/oppbygging/)

<sup>2</sup> The European Credit Transfer and Accumulation System (ECTS) is a tool of the European Higher Education Area for making studies and courses more transparent.

<sup>3</sup> The project covered several aims, such as the functioning of the assessment platform, the structuring of tasks within the platform, visual presentations of images, etc. For further elaboration, see de Lange *et al.* (2018).

<sup>4</sup> Informants recalled their concurrent thinking prompted by a visual display of the relevant exam.

## References

- Bloxham, S. & Boyd, P. (2007) *Developing effective assessment in higher education: A practical guide* (New York, Open University Press).
- Boud, D. & Falchikov, N. (2007) Introduction: Assessment for the longer term, in: D. Boud & N. Falchikov (Eds) *Rethinking assessment for higher education: Learning for the longer term* (London, Routledge), 3–13.
- Boud, D. & Soler, R. (2016) Sustainable assessment revisited, *Assessment & Evaluation in Higher Education*, 4(3), 400–413.
- Boyle, A. & Hutchison, D. (2009) Sophisticated tasks in e-assessment: What are they and what are their benefits?, *Assessment & Evaluation in Higher Education*, 34(3), 305–319.
- Braun, V. & Clarke, V. (2006) Using thematic analysis in psychology, *Qualitative Research in Psychology*, 3(2), 77–101.
- Brodal, P. (2016) Hvordan kan legestudiet ivareta grunnleggende profesjonelle verdier, *Uniped*, 39(4), 345–356.
- Cassell, C. & Johnson, P. (2006) Action research: Explaining the diversity, *Human Relations*, 59, 783–814.
- Damsa, C., de Lange, T., Elken, M., Esterhazy, R., Fosslund, T., Frølich, N. *et al.* (2015) *Quality in Norwegian higher education. A review of research on aspects affecting student learning*. Report 2015:24 (Oslo, Nordic Institute for Studies in Innovation, Research and Education).
- Damsa, C. & de Lange, T. (2019) Student-centred learning environments in higher education. From conceptualization to design, *Uniped*, 42(1), 9–26.
- Deeley, S. (2018) Using technology to facilitate effective assessment for learning and feedback in higher education, *Assessment & Evaluation in Higher Education*, 43(3), 439–448.
- de Lange, T., Møystad, A. & Torgersen, G. R. (2018) Increasing clinical relevance in oral radiology: Benefits and challenges when implementing digital assessment, *European Journal of Dental Education*, 22(3), 198–208.
- de Lange, T. & Nerland, M. (2018) Learning to teach and teaching to learn: Exploring microteaching as a site for knowledge integration in teacher education, in: P. Maassen, M. Nerland & L. Yates (Eds) *Reconfiguring knowledge in higher education (Higher education dynamics, vol. 50)* (Cham, Springer), 169–185.
- Galuppo, L., Gorli, M. & Ripamonti, S. (2011) Playing dissymmetry in action research: The role of power and differences in promoting participative knowledge and change, *Systemic Practice and Action Research*, 24(2), 147–164.
- Ganesan, A., Alakhras, M., Brennan, P. C. & Mello-Thoms, C. (2018) A review of factors influencing radiologists' visual search behaviour, *Journal of Medical Imaging and Radiation Oncology*, 62(6), 747–757.

- Gillis, A., Morris, M. C. & Ridgeway, P. F. (2015) Communication skills assessment in the final postgraduate years to established practice: A systematic review, *Postgrad Medical Journal*, 91, 13–21.
- Hay, P., Engstrom, C. A., Green, A., Friis, P., Dickens, S. & Macdonald, D. (2013) Promoting assessment efficacy through an integrated system for online clinical assessment of practical skills, *Assessment & Evaluation in Higher Education*, 38(5), 520–535.
- Hendricson, W. D. (2012) Changes in educational methodologies in predoctoral dental education: Finding the perfect intersection, *Journal of Dental Education*, 76(1), 118–141.
- Hermanowicz, J. C. (2016) Longitudinal qualitative research, in: M. J. Shanahan, J. T. Mortimer & M. K. Johnson (Eds) *Handbook of the life course* (Madison, WI, Springer), 491–513.
- Khatami, S. & MacEntee, M. I. (2011) Evolution of clinical reasoning in dental education, *Journal of Dental Education*, 75(3), 321–328.
- Mäkitalo, Å. (2012) Professional learning and the materiality of social practice, *Journal of Education and Work*, 25(1), 59–78.
- Mello-Thoms, C., Dunn, S. M., Nodine, C. F. & Kundel, L. (2003) The perception of breast cancers: A spatial frequency analysis of what differentiates missed cancers from reported cancers, *IEEE Transactions on Medical Imaging*, 22(10), 1297–1306.
- Muller, J. (2009) Forms of knowledge and curriculum coherence, *Journal of Education and Work*, 22(3), 205–226.
- Nerland, M. (2012) Professions as knowledge cultures, in: K. Jensen, L. Lahn & M. Nerland (Eds) *Professional learning in the knowledge society* (Rotterdam, Sense Publishers), 27–48.
- Rata, E. (2019) Knowledge-rich teaching: A model of curriculum design coherence, *British Educational Research Journal*, 45(4), 681–697.
- Robinson, P. J. (1997) Radiology's Achilles' heel: Error and variation in the interpretation of the Röntgen image, *British Journal of Radiology*, 70(839), 1085–1098.
- Seddon, J. (2008) Vets and videos: Student learning from context-based assessment in a pre-clinical science course, *Assessment & Evaluation in Higher Education*, 33(5), 559–566.
- Silverman, D. (2013) *Doing qualitative research: A practical handbook* (Los Angeles, CA, Sage).
- Snyman, D. W. & Kroon, J. (2005) Vertical and horizontal integration of knowledge and skills: A working model, *European Journal of Dental Education*, 9(1), 26–31.
- Stödberg, U. (2012) A research review of e-assessment, *Assessment & Evaluation in Higher Education*, 37(5), 591–604.
- Tennant, M., McMullen, C. & Kaczynski, D. (2010) *Teaching, learning and research in higher education: A critical approach* (New York, Routledge).
- Thomason, R., Plumridge, L. & Holland, J. (2003) Longitudinal qualitative research: A developing methodology, *International Journal of Social Research Methodology*, 6(3), 185–187.
- Timmis, S., Broadfoot, P., Sutherland, R. & Oldfield, A. (2016) Rethinking assessment in a digital age: Opportunities, challenges and risks, *British Educational Research Journal*, 42(3), 454–476.
- van Driel, J. H., Beijgaard, D. & Verloop, N. (2001) Professional development and reform in science education: The role of teachers' practical knowledge, *Journal of Research in Science Teaching*, 38(2), 137–158.
- White, S. & Pharoah, M. J. (2009) Principles of radiographic interpretation, in: S. White & M. J. Pharoah (Eds) *Oral radiology: Principles and interpretations* (St Louis, MO, Elsevier), 281–296.
- Whitelock, D. (2010) Activating assessment for learning: Are we on the way with Web 2.0?, in: M. J. W. Lee & C. McLoughlin (Eds) *Web 2.0-based e-learning: Applying social informatics for tertiary teaching* (Sindey, PA, IGI Global), 319–342.