Multimedia Discrepancies

Plenary Lectures as Perceived by Students

Øystein Olav Skaar
Assistant professor / research assistant
University of Bergen. Department of Education. E-mail: Oystein.Skaar@psyip.uib.no

Rune Johan Krumsvik
Professor
University of Bergen. Department of Education. E-mail: Rune.Krumsvik@psych.uib.no

SAMANDRAG

Artikkelen ynskjer å skildre studentar i høgare utdanning sine haldningar til og oppfatningar av førelesing, og særskilt bruk av multimodale presentasjons-program (t.d. PowerPoint) og tradisjonell tavleundervising. Det vart utvikla to haldningsskalaar med fire påstandar, for å måle studentane sine oppfatningar av (1) undervisingsstruktur, (2) læringsutbytte, (3) motivasjon til å delta på under-vising og (4) interaksjon mellom studentar og forelesar når ein av to under-visingsmedium vart brukt. Studentar (N = 174, 94,8% fullføringsrate) frå anten Universitetet i Bergen eller Norsk Lærarakademi (NLA) vart spurde om ta del i ein eksplorativ studie som tok i bruk eit personleg responssystem («clickers»). Studien gir indikasjonar på at mange studentar ynskjer meir bruk av komplekse multimodale presentasjonar, som inkluderer animasjonar og/eller videoar. Sam-stundes er positive haldningar til multimodale presentasjonsprogram avhengig av studenten sitt føretrekte undervisingsformat og studenten si oppfatning av fore-lesar sin digitale og didaktiske kompetanse.

Nøkkelord

digital kompetanse, undervisingsmedium og metodar, høgare utdanning, kognitiv teori om multimedialæring

ABSTRACT

The present study aim to describe students' attitudes and perceptions toward plenary lectures, and more specifically, the use of multimodal presentations (e.g., PowerPoint) and traditional lectures (e.g., chalk and talk). Two attitude scales were built upon four items measuring students' perception of the (1) *lecture structure*, (2) *learning outcome*, (3) *motivation* to attend lectures and (4) *interaction* between students and lecturer when one of the two lecturing mediums were used. Students (N = 174, 94.8% completion rate) from either the University of Bergen or NLA University College were asked to take part in an exploratory survey using a personal response system ("clickers"). The study suggest that many students wish for more use of complex multimodal presentations (including animations and/or videos). Yet, positive attitudes toward such mediums are conditional on students' preferred lecture format and students' perception of their lecturers' digital and didactic competence.

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INTRODUCTION

Why do we use multimodal presentations (e.g. PowerPoint) in plenary lectures? Is it on the assumption that integration of ICT in higher education will result in higher study quality, and consequently greater learning outcomes for the students? Alternatively, is it simply because of the ease in making these presentations, and the software's low-threshold interface? The answer is that *why* is not really that important, not for the students. The content matters, not whether we use PowerPoint, blackboards, or overhead projectors. Therefore, the question ought to be: How do we use instructional media, and how do the students perceive our practice and our intentions?

The purpose of this paper is to present the results of an exploratory study on how 165 students (N = 174) from higher education experience plenary lectures, and how they perceive the practice of multimodal presentations and traditional lectures (i.e. blackboard and chalk lectures). Moreover, the paper intends to explore the possible relationship between *lecturers' digital literacy, didactic awareness, lecturers' clarity* and students' *preferred lecture format* in relation to their attitudes toward said instructional media.

Digital literacy, within an educational discourse, is the "teacher's ability to use ICT in a professional context with good pedagogic-didactic judgement and his/her awareness of its implications on learning strategies and on the digital Bildung of pupils" (Krumsvik, 2009, p. 177). Didactic awareness, on the other hand, is the lecturers' understanding of, and ability to apply, current research on how students best learn from plenary lectures. Lecturer clarity is defined as the lecturers' ability to communicate teaching intentions through multimodal presentations (adopted from Bloom's Taxonomy, cf., Bloom, 1956; Krathwohl, 2002). Preferred lecture format depicts the students' most favourable learning scenario, based on various degrees of interaction between students and a lecturer during lectures.

Richard Mayer's (2009) Cognitive Theory of Multimedia Learning (CTML) is applied to further analyse the results, based on the assumption that attitudes play a key role in how students are able to get a deep understanding of the learning material. Deep learning, in contrast to shallow-level factual understanding (e.g. parrot-talk), includes deeper meaning-building, reflective, evaluative/transformational and metacognitive processes (Mayer, 2009).

The objective is operationalized through four research questions (see Table 1), and the paper begins with a brief account on the plenary lecture and its relationship with instructional media.

RESEARCH QUESTIONS

TABLE 1. RESEARCH QUESTIONS

Research Question 1	How do students perceive plenary lectures, and the use of multimodal presentations and traditional lectures?
Research Question 2	Do lecturers' digital literacy and didactic awareness correlate with students' attitudes toward traditional lectures and multimodal presentations?
Research Question 3	Do preferred lecture format and lecturer clarity correlate with students' attitudes toward traditional lectures and multimodal presentations?
Research Question 4	When controlled for effects of other variables from Research Questions 3 and 4, is digital literacy a significant predictor of students' attitudes toward traditional lectures and multimodal presentations?

PLENARY LECTURES AND INSTRUCTIONAL MEDIA

Whether deserved or not, recent years witnessed a decline in the reputation of the traditional monologue-based lecture (Halleraker, 2012; Kvernbekk, 2012). Still, in spite of its prominent position within higher education, plenary lectures have received little attention in educational research (Krumsvik, Westrheim, Sunde & Langørgen, 2012; Kvernbekk, 2011b). By way of contrast, Microsoft PowerPoint, the almost omnipresent instructional medium, is a continuous subject for debate, twenty-five years after its initial launch (Doumont, 2005; Savoy, Proctor & Salvendy, 2009; Sætra, 2012; Tufte, 2006). Each year more than ten billion slide presentations are given, and the presence of PowerPoint and similar software in plenary lectures is nearly universal (Parks, 2012; Savoy et al., 2009). Though several studies (Apperson, Laws & Scepansky, 2006; Conole, de Laat, Dillon & Darby, 2008; Corbeil, 2007; Susskind, 2005) indicate that students prefer multimodal presentations (e.g. PowerPoint) over traditional lectures (e.g. chalk and talk), there is little evidence that the former fosters better learning outcomes, and some studies even point to the opposite (Amare, 2006; Savoy et al., 2009).

Multimodal presentation software entails an opportunity for combining different modalities, for example verbal (i.e. written and oral text) and non-verbal (e.g. images and environmental sounds) representations (Moreno & Mayer, 2007). Nevertheless, opportunities do not necessarily require execution and many lecturers use therefore de facto *unimodal,* text-based presentations (Hammerstad, 2011; Mann & Robinson, 2009). Alternatively, a traditional lecture may in fact be multimodal by combining chalk and talk with other media such as overhead projectors and video presentations (Mayer, 2009). However, whereas consensus is rarely found within educational research, most researchers would agree instructional media do not promote learning themselves, but through the appropriate use of instructional methods (Castells, 2001; Clark & Feldon, 2005; Schunk, 2012). Thus, rather than dwelling on media and their native multifarious opportunities, the question becomes, in what manner does one learn, and what methods foster better learning?

Cognitive Theory of Multimedia Learning

The theoretical framework for this study adapted CTML as developed by Richard Mayer and his colleagues over the last two decades. Mayer (2009) defines multimedia learning as the building of coherent mental models from words (i.e. written and spoken words) and pictures (e.g. illustrations, diagrams, animation or videos). The mental models represents important aspects and associations of perceived information. CTML assumes that verbal and non-verbal representations are qualitatively different, and though words and graphics may complement one another and even describe the same phenomenon, "the resulting verbal and pictorial representations are not informationally equivalent" (Mayer, 2009, p. 227). Cognitive research has shown that one learns more deeply with graphics, and CTML claim that one learns more deeply from words and graphics than from words alone (Clark & Mayer, 2011; Wolfe, 2010).

Generative processing, which is required for the student to make sense of the presented learning material, is an important aspect of CTML (Mayer, 2011a). These processes require an active agent, and are dependent on prior knowledge and support during the lesson. This differs from notions that the learner is a passive recipient of knowledge (e.g. Locke's *tabula rasa*). Instead, learning is the outcome of cognitive processes that are both constructive and regenerative (Fletcher & Tobias, 2005). Hence, the generative assumption implies that motivation and attitudes, in addition to metacognition, are important factors for deeper learning (Mayer, 2009).

The lecturer, by using words and pictures through thought-provoking and concise material, may increase students' motivation (Kalyuga, 2007; Marzano, 1992). However, while pictures may foster motivational interest, it does not necessarily improve factual or conceptual knowledge (Harp & Mayer, 1997, 1998). Studies indicate that only instructive pictures, relevant to the learning material, foster learning. Decorative and seductive pictures not directly relevant to the learning material do not, and the latter may even prevent learning (Sung & Mayer, 2012; Tangen et al., 2011). Moreover, most of the learning methods within CTML tend to have the best effect on low-knowledge learners (e.g. novice students) rather than high-knowledge learners (e.g. advanced students), and when the material is system-controlled, complex and fast-paced (Mayer, 2009). The *expertise reversal effect* is a result of conditions whereby the learning methods fail to foster learning. For instance, worked-out examples and direct instruction may be fruitful for low-knowledge learners, but a hindrance for high-knowledge learners, who according to Kalyuga (2009) would benefit more from problem-solving practice and guided exploratory environments. Whereas prior knowledge seems to be an important factor, the cognitive style (e.g. "visualizers and verbalizers") of the learner is not (Mayer, 2011a).

As such, lecturers' practical judgment ought to be seen as a way of enhancing evidence-based practice by identifying and adapting principal theories (e.g. CTML) to corresponding contexts (Kvernbekk, 2011a, 2012). Hence, it is rea-

sonable to assume that the use, or misuse, of an instructional medium reflects to some extent lecturers' awareness of current research on how students best learn from lectures. Similarly, it reflects lecturers' proficiency with the respective medium.

Digital Literacy

Reports surrounding digital literacy, multimedia learning and the use of ICT in higher education is a recurring topic in the Norwegian media (Eikeseth, 2013; Hammerstad, 2011; Mostad, 2012; Studvest, 2011; Sætra, 2012, 2013) and public documents (Meld. St. 23 (2012–2013); St.meld. nr. 19 (2008–2009)). However, regardless of their intentions, these statements and opinions are often normative in nature and lack an empirical and theoretical foundation (Krumsvik, 2009; Krumsvik & Ludvigsen, 2012; Official Norwegian Reports 2013, p. 2, 2013; Torgersen, 2012). Different discourses require different sets of skills, and the digital literacies needed for an instructor have to surpass basic digital abilities and those found among the general population (Krumsvik & Almås, 2009). Within an educational discourse, digital literacy is the "teacher's ability to use ICT in a professional context with good pedagogic-didactic judgement and his/her awareness of its implications on learning strategies and on the digital Bildung of pupils" (Krumsvik, 2009, p. 177). The theory is grounded in the Bergen Digital Literacy Scale (see Figure 1) developed by Rune Johan Krumsvik (2008, 2011). In a recent study conducted on teachers from upper secondary education ($n = 2579$), the scale was demonstrated to be theoretically and empirically robust (Krumsvik, 2013; Krumsvik, Egelandsdal, Sarastuen, Jones & Eikeland, 2013).
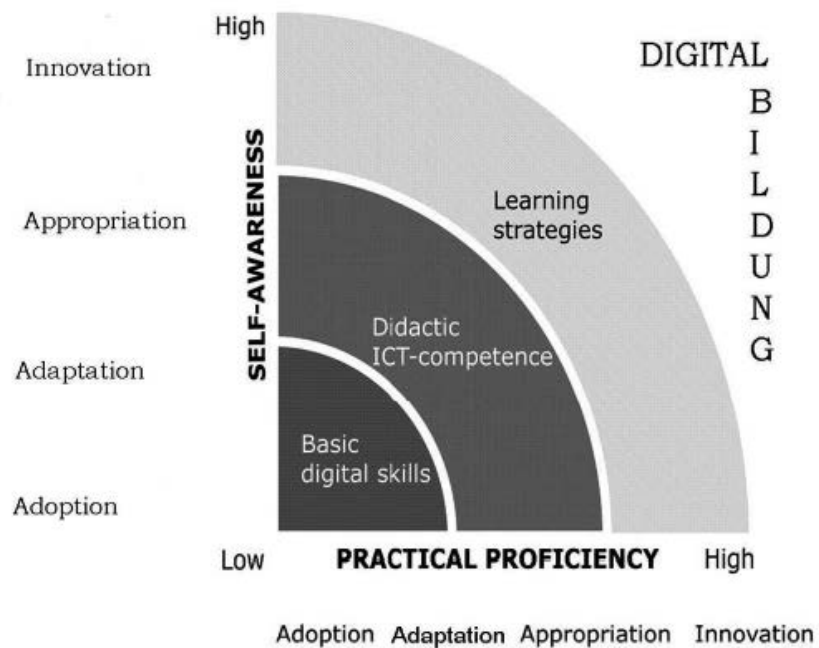

Figure 1. Bergen Digital Literacy Scale (Krumsvik, 2012)

The middle component in Figure 2, *didactic ICT competence and appropriation*, is of special interest for this current study. The component encompasses "the ability to use digital tools in subjects in order to achieve competence-based aims, which requires an extended competence on the part of the teacher in terms of seamlessly incorporating the subject matter, pedagogy and digital competence" (Krumsvik, 2012, p. 46). Consequently, the digital tool (e.g. PowerPoint) has to be used with a clear purpose and the teaching intentions need to be communicated to the students ("lecturer clarity", Hattie, 2009, 2011; Krumsvik & Ludvigsen, 2013; Seidel, Rimmele & Prenzel, 2005; Wayne & Youngs, 2003).

Mayer (2009) claims questions regarding which instructional medium is best are unproductive, but the question raised in this study is not whether Power-Point is objectively better than a blackboard, but rather how students experience plenary lectures and how they perceive the practice of these media. If one accepts Mayer's argument concerning generative processing, it would be appropriate to assert that students' attitudes toward instruction media have some influence in their ability to foster meaningful learning. The following sections intend to shed some light on these attitudes based on the opinions of a medium-sized sample of Norwegian students.

METHODS

Participants

The empirical data was acquired from 165 students (N = 174, 94.8% completion rate), attending higher education at either the University of Bergen or the Norwegian Teacher Academy (NLA University College). The respondents were approached through convenience sampling, and data was collected from four separate sessions from four study programmes. Students from an introductory course in *psychology* (*n* = 22), third year *dentistry* (*n* = 27), first year *education* (*n* = 56) and final year *medicine* (*n* = 60) were to complete a survey within a cross-sectional design and exploratory survey research.

Procedure

Data collection entailed direct administration by the authors, with each session conducted in the students' regularly used auditoriums. The material consisted of a questionnaire developed for the study, based on the works of Joshua E. Susskind (2005) and Krumsvik (Krumsvik & Ludvigsen, 2012; Krumsvik, Ludvigsen & Urke, 2011). The survey was presented as a series of PowerPoint slides, with data gathered through a personal response system ("clickers", TurningPoint, 2012).

Materials

Serving as the main instruments for the study were two scales (dependent variables) developed to obtain students' attitudes toward multimodal presentations (AtMP) and traditional lectures (AtTL). The two theoretical constructs measured a mean average of the degree to which the students agreed or disagreed that (1) lectures were more *structured,* (2) their *learning outcomes* were better, (3) their *motivation* to attend lectures was greater, and (4) the *interaction* between lecturer and students was heightened when one of the aforementioned instructional media were used. Furthermore, each of the four dimensions were measured on a 7-point Likert-type scale that ranged from 1 = completely disagree; 2 = strongly disagree; 3 = slightly disagree; 4 = neither agree nor disagree; 5 = slightly agree; 6 = strongly agree; and 7 = completely agree. Factor analysis (principal axis factoring) and reliability tests (Cronbach's alpha) indicated that AtMP (63.4% shared variance, $\alpha = .88$) and AtTL (67.2% shared variance, $\alpha = .89$) were both unidimensional and acceptably reliable as psychometric constructs.

In addition to the two dependent variables, four independent variables were the basis for further statistics. The students were asked to assess their lecturers' (1) *digital literacy*; (2) *didactical awareness;* specify their (3) *preferred lecture format*; and their perception of (4) *lecturer clarity* during plenary lectures.

The digital literacy item was measured on a scale from one (no skills) to seven (highly skilled); whereas the didactical awareness item was measured on a 7-point Likert-type scale equal to AtMP and AtTL. Preferred lecture format and lecturer clarity were both categorical variables (see Appendix I for an overview).

Data Analysis

Three main statistical approaches, in addition to descriptive analyses, were carried out to answer the research questions. First, frequencies and averages was calculated for students' perception of plenary lectures among the four study programmes. This included all variables used in the study (Research Question 1: *Plenary Lectures as Perceived by Students*). Second, the relationship between attitudes on one hand and digital literacy and digital awareness on the other (Research Question 2: *Attitudes, Digital Literacy and Didactic Awareness Relationship)* was analysed by employing a two-tailed Pearson's correlation. Third, the relationship between preferred lecture format, lecturer clarity and attitudes (Research Question 3: *Attitude, Lecture Format and Lecturer Clarity Relationship*) was analysed by one-way analysis of variance (ANOVA). Finally, a multiple regression analysis was conducted to measure whether digital literacy was able to predict a significant amount of variance in attitudes when controlled for variables in Research Questions 2 and 3 (Research Question 4: *Attitude Predicted by Digital Literacy*).

FINDINGS

Research Question 1: Plenary Lectures as Perceived by Students

A large majority of the students reported that multimodal presentations comprised the most frequently used instructional medium (74.2%, $n = 121$), in contrast none reported that traditional lectures were used as the sole medium. Only two students (1.2%) reported that the lecturers spent the most time on traditional lectures when the two media were used together, whereas almost a quarter (23.9%, $n = 39$) stated the opposite. It is therefore clear, according to the students in this study, that multimodal presentations comprise a dominant feature of their lectures.

The students were then asked about common usage of multimodal presentations in their lectures and, similar, what features would be best for their actual learning outcomes (see Figure 2). Nearly half answered that written text and graphics, in combination with oral text (basic multimodal), were the most common trait. The second largest group replied that presentations were commonly written and oral text only (unimodal). Less than ten per cent answered that animations and/or videos (complex multimodal) were part of the regular practice.

By way of contrast, more than half of the respondents answered that they believed a presentation with complex multimodal elements would be best for their learning outcomes. Thus, many students reported a notable discrepancy between perceived needs and observed availability, with no differences among the study programmes. Nonetheless, neither perceived use nor believed learning outcomes from multimodal presentations shared a relationship with students' attitudes toward instructional media. To illustrate, students who reported that they would learn better from complex multimodal presentations did not report more positive attitudes toward PowerPoint than students who preferred unimodal lectures.
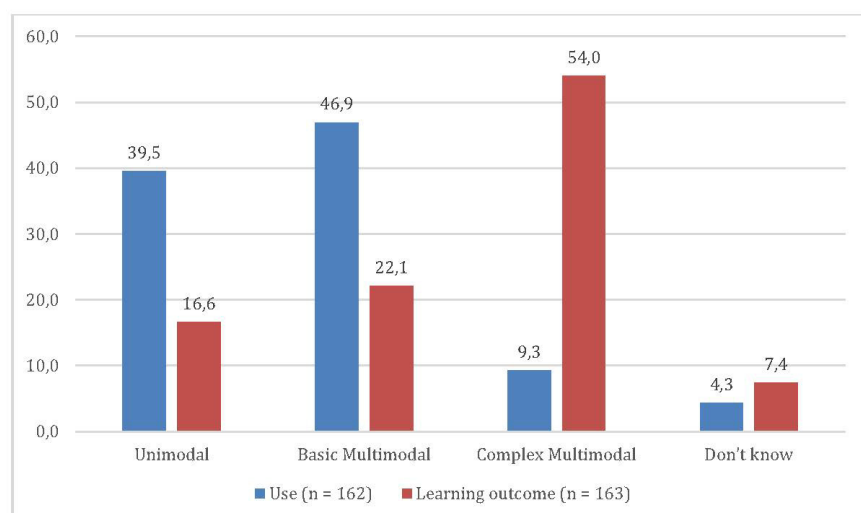

Figure 2. Use and learning outcomes of multimodal presentations as perceived by students. Per cent.

Digital literacy and didactic awareness

The students, with psychology as a notable exception, rated their lecturers' digital literacy to be less than intermediate (four on the scale, see Figure 3). The students had more diverse ratings regarding their lecturers' didactic awareness, and especially the novice students from psychology and education were cautiously positive that their lecturers were aware of current research on how students best learn from plenary lectures.
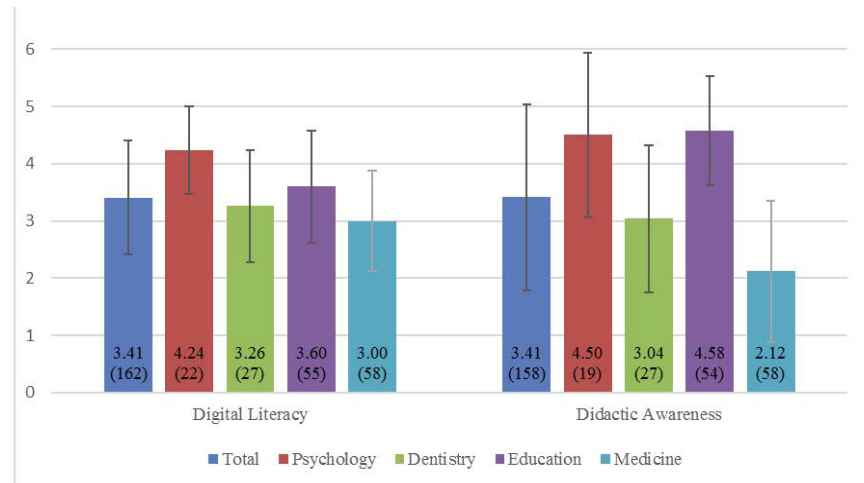

Figure 3. AtMP and AtTL scales by study programme. Means and standard deviations, sample size in parentheses.

Students' preferred lecture format

The results concentrated on three main groups (see Figure 4). A majority of the students preferred monologue, dialogue and discussion between students, or the former in addition to case studies (high interaction) during their lectures, while the smaller groups preferred monologue (low interaction) or a mixture of monologue and dialogue (medium interaction). A noticeable difference was the medicine students' lack of interest in low interaction lectures.
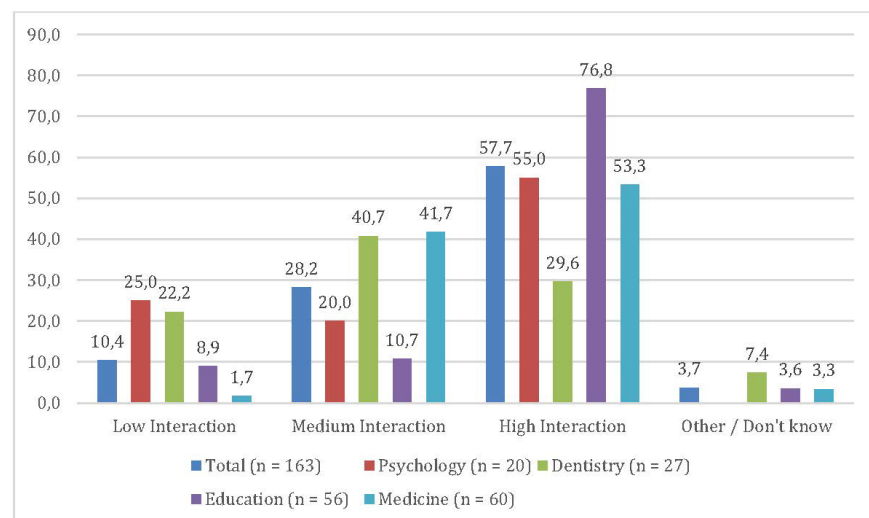

Figure 4. Preferred lecture format by study programme. Per cent.

Lecturer clarity

The distribution of students was set within four key groups (see Table 5). The three largest groups answered that the main intent behind their lecturers' use of multimodal presentations was (a) to *remember the subject matter* (factual), (b) to *understand the subject matter* (conceptual) or (c) they *did not know.* As a final group, *apply, analyse, evaluate* and *create new understanding of the subject matter* were collapsed into the category (d) *procedural and metacognitive*. Again, the medicine students were clearly divergent in regards to the other study programmes, and made up a large percentage of the factual and do not know groups.
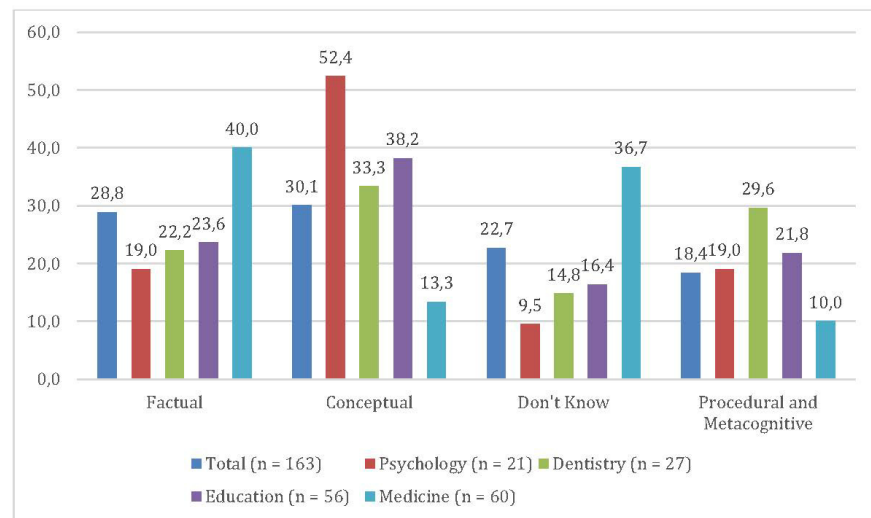

Figure 5. Lecturer clarity. Per cent.

Attitudes toward multimodal presentations and traditional lectures

According to the average means of approximately four (neither agree nor disagree), there were seemingly no dissimilarities between AtMP and AtTL (see Figure 6, and Appendix II for subscale items). The subscale items indicated that interaction between student and lecturer was the greatest benefit from traditional lectures, while structure was the greatest strength of multimodal presentations.

However, a scatterplot identified a strong negative linear relationship between AtMP and AtTL, and a Pearson's correlation supported the graphical assessment (see Appendix III). Thus, positive attitudes toward one learning medium would likely signify negative attitudes toward the other. Moreover, the standard deviations (i.e. black error bars) seen in Figure 6 also indicated large individual variance, and it was clear that the medicine students differed significantly from the other study programmes. Accordingly, the remaining research questions try to explain these differences on the basis of digital literacy, didactic awareness, preferred lecture format and lecturer clarity.
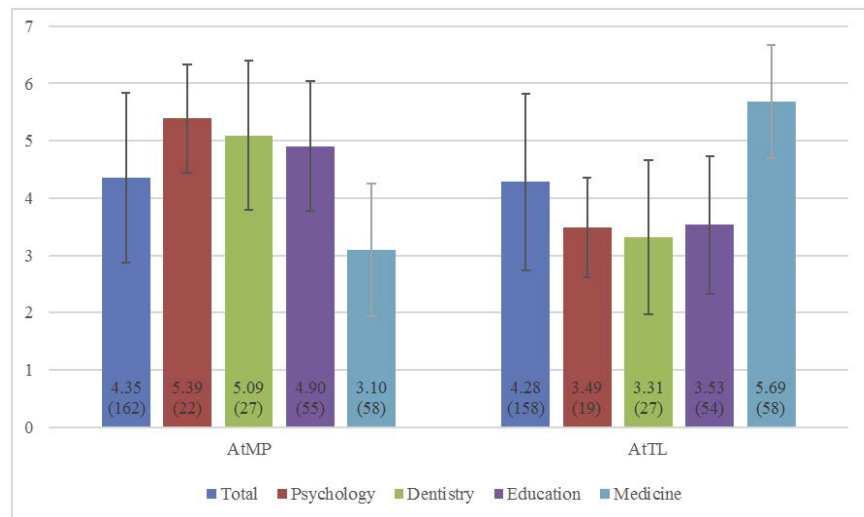
Figure 6. AtMP and AtTL scales by study programme. Means and standard deviations, sample size in parentheses.

Research Question 2: Attitudes, Digital Literacy and Didactic Awareness Relationship

The results (see Appendix III) indicated the higher the students' rating of their lecturers' didactic awareness and digital literacy, the more likely they were to have a positive attitude toward multimodal presentations, and similarly a negative attitude toward traditional lectures. Furthermore, there was also a significant positive relationship between didactic awareness and digital literacy, indicating that students link the two properties.

Research Question 3: Attitude, Lecture Format and Lecturer Clarity Relationship

The results for AtMP and AtTL by preferred lecture format (see Figure 7) revealed that students who preferred low interaction during plenary lectures scored higher on AtMP and lower on AtTL than the other groups, but only significantly so from high interaction.
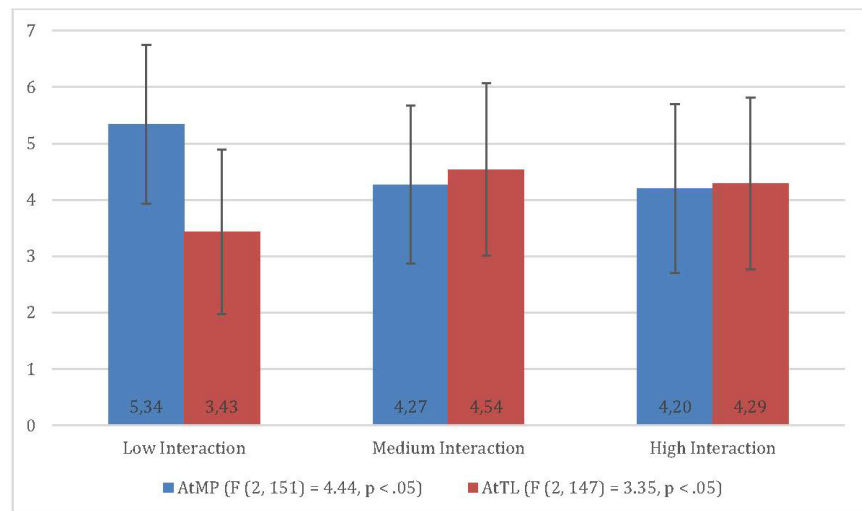
Figure 7. AtMP and AtTL scales by preferred lecture format. Means and standard deviations.

The results for AtMP and AtTL by lecturer clarity (see Figure 8) mimicked common sense and implied that students, who reported that they did not know what intentions their lecturer had with their PowerPoint presentations, scored lowest on the AtMP scale, and likewise highest on AtTL. The factual knowledge group (i.e. remember the subject matter) was not significantly different from the aforementioned students, but scored significantly lower than conceptual (i.e. understand the subject matter) and procedural and metacognitive (i.e. apply, analyse, evaluate and/or create new understanding of the subject matter) groups on AtMP and AtTL.
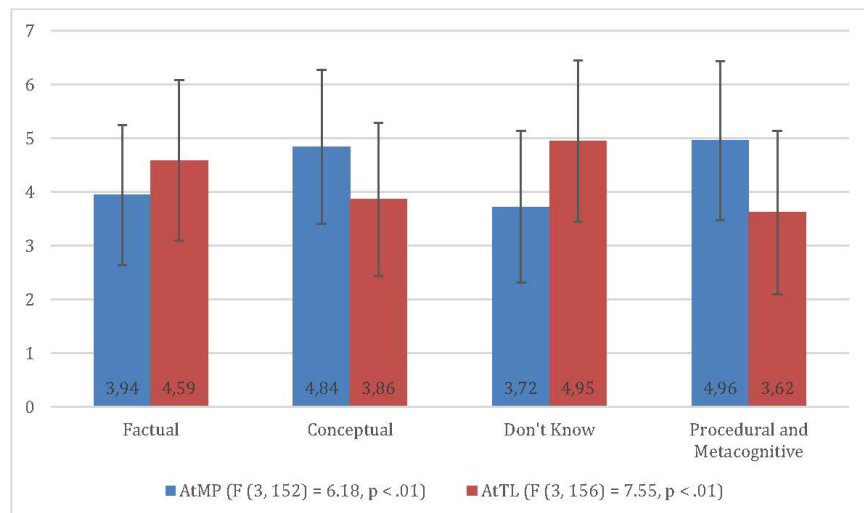

Figure 8. AtMP and AtTL scales by lecture clarity. Means and standard deviations.

Research Question 4: Attitude Predicted by Digital Literacy

The four independent variables in the regression models were able to explain thirty-seven per cent of the total variance in AtMP and twenty-seven per cent

for AtTL (see Appendix IV). Digital literacy and didactic awareness shared a significant relationship with attitudes toward multimodal presentations, indicating that the higher the score on these two variables, the higher the score on AtMP. Of the two, only didactic awareness was significant for AtTL, meaning that the higher score on didactic awareness, the lower the score on AtTL. Lecturer clarity was not significant in either of the models, indicating that the other variables were better at explaining the variances in students' attitudes. Preferred lecture format, on the other hand, revealed itself to have a strong relationship with both AtMP and AtTL. Students who preferred low interaction during plenary lectures scored higher on AtMP and lower on AtTL than those who preferred medium or high interaction.

Summary of Findings

Thus, if a student reported a preference for low interaction during plenary lectures and rated lecturers' digital literacy and digital awareness as high, the model would predict a strong agreement with the lectures as more (1) structured; (2) learning outcomes better; (3) motivation to attend lectures greater and heightened (3) interaction between lecturer and students by using multimodal presentations. Alternatively, if the student preferred high interaction and rated lecturers low on both digital literacy and digital awareness, the prediction would change to a strong disagreement with these statements.

DISCUSSION

The results from this study indicate that the frequent use of PowerPoint in plenary lectures is consistent with findings by the Norway Opening Universities (NOU, 2011). The results also pointed to a strong negative relationship between AtMP and AtTL, meaning that positive attitudes toward one of the instructional media largely were identified by negative attitudes toward the other. On a sub-level of the scales, the results suggested structure was the greatest strength of multimodal presentations, whereas interaction between student and lecturer was the greatest benefit from traditional lectures. This seems to be in line with previous research (Hill, Arford, Lubitow & Smollin, 2012; James, Burke & Hutchins, 2006; Szabo & Hastings, 2000).

Furthermore, a majority of the students scored higher on the AtMP than the AtTL scale, that is, they reported generally more positive attitudes toward multimodal presentations than traditional lectures. This is also in conformity with NOU findings (2011). A clear deviation from this assumption was found among the medicine graduates, who scored high on AtTL and low on AtMP. The reasons for the disparities between the study programmes are difficult to obtain, due to limitations with the research design and variables used, though nothing from the data indicated a more frequent use of traditional lectures. It could be as simple as a preference for the instructional medium, or for lecturers who use traditional lectures (or against lecturers who use multimodal presen-

tations), and as such, it is likely that attitudes toward the lecturers may have introduced conscious or unconscious bias toward one medium.

It is worth noticing that 36.7 per cent of the medicine students answered they could not identify (did not know) the intent behind their lecturers' use of multimodal presentations, and another 40 per cent answered that factual knowledge (remember the subject matter) was the main intent. Interpreted through CTML, the results may indicate that these students do not perceive the applied presentations as adapted to foster deep meaningful learning (Mayer, 2002). In addition, only 1.7 per cent of the medicine students reported a preference for plenary lectures characterized by monologue (low interaction), and the medicine students rated their lecturers' digital literacy and digital awareness most poorly of the study programmes.

The analyses predicted that respondents with these characteristics would be most doubtful toward multimodal presentations. This trend was still apparent when the medicine students were removed from the equation. On the other hand, Students from dentistry also reported somewhat low ratings on these items, but unlike medicine, dentistry had a high mean score on the AtMP scale. A reason for this may be that 62.9 per cent of the dentistry students answered procedural and metacognitive knowledge on the lecturer clarity question and over 20 per cent preferred low interaction during lectures.

Another explanation stems from the fact that the medicine students, being graduates on their sixth year, were more experienced than third-year dentistry, first-year education and psychology students. This may indicate that (a) novice students have less experience and in-depth knowledge of their field and are therefore less able to assess their lectures; and/or (b) lecturers' didactical awareness is more acutely aligned with the needs of low-knowledge students and use the same methods regardless of knowledge level among the students (Kirschner, Sweller & Clark, 2006). The latter share characteristics with Slava Kalyuga's (2007) definition of expertise reversal effect as "imbalances between learner organized knowledge base and provided instructional guidance" (p. 26). Since there is a close relationship between motivation and germane processing, lecturers need to adapt teaching methods according to the learners' intrinsic goals, in order to foster meaningful learning (Kalyuga, 2007; Mayer, 2011b).

Thus, it is reasonable to believe the four independent variables may contribute to student attitudes, though only digital literacy, lectures' awareness and preferred lecture format were statistical significant in the final model. This implies that lecturer clarity, preferred lecture and presentation format may play a notable part in students' attitudes. Though it would be inappropriate to make any inferences or causality claims based on these figures, they may reflect differences concerning preferences toward either a lecture-based or student-centred learning environment, and that some students perceive the usage of multimodal presentations as nurturing the former (Baeten, Struyven, & Dochy, 2013; Lea, Stephenson & Troy, 2003).

Implications

Due to the sparse research on learning outcomes from plenary lectures in Norwegian higher education, the current study depicts some descriptive observations that are interesting in their own right. It is reasonable to argue that lecturers' use of one medium or the other affects students' attitudes toward such media. As such, students' notions of their lecturers' digital literacy and didactic awareness seem to share a positive relationship with their attitudes towards multimodal presentations. The results also suggest that students relate lecturers' didactic awareness with lecturers' digital literacy. That is, a high score on digital literacy likely meant the student thought their lecturers were more aware of current research on how students' best learn from plenary lectures. Interesting, since few within teacher education seem not to relate these two qualities (Krumsvik et al., 2012).

Though some students preferred traditional lectures, a majority of these would still claim that complex multimodal presentations are best for their learning outcomes. Even so, unimodal presentations accounted for almost forty per cent of the PowerPoint practice, which strengthens the notion that the intrinsic possibilities of the software are not always used. According to CTML, lecturers who only use words will lose an opportunity to foster learning, since information is channelled mostly through the verbal part of the working memory and therefore neglects the pictorial model. The aforementioned Bergen Digital Literacy Scale may explain this multimedia discrepancy as inadequate incorporation of subject matter, pedagogy and digital competence. This may indicate, in part, that ambivalent attitudes toward multimodal presentations are not directed towards the instructional medium itself, but rather towards methods and content used.

Thus, if students hope for complex multimodal presentations, future research (e.g. through experimental design) needs to address to what extent such presentations benefit their objective learning outcomes, and not just their interest and motivation. Although combining various media may not need a proficiency level beyond basic computer and specific software skills, Cognitive Theory of Multimedia Learning states that redundant information, whether it is words or pictures, may weaken or even reverse meaningful learning. Accordingly, it makes sense that combining more media equals a greater risk of adding redundant information. Consequently, there is a call for a lecturer education that emphasizes the importance of digital literacy and didactic awareness, and provides an opportunity to develop these attributes.

Limitations

The exploratory study measured students' subjective assessment of their own learning outcomes, thus it may or may not reflect their actual dividends or the actual usage of multimodal presentations and traditional lectures. Furthermore, the study is thereto limited by the empirical constraints associated with self-reporting measures and convenience sampling.

ACKNOWLEDGEMENTS

APPENDICES

Appendix I

Preferred Lecture Format and Lecturer Clarity

Item	Type	n	%
Preferred Lecture Format			
I prefer lectures that are characterized by	Monologue	17	10.3
	Mixture of monologue and dialogue	46	27.9
	Mixture of monologue, dialogue and discussion with fellow student.	37	22.4
	Mixture of monologue, dialogue, discussion with fellow student and case study.	57	34.5
	Other	4	2.4
	Don't know	2	1.2
	Missing	2	1.2
	Total	165	100
Lecturer Clarity			
When lecturers in your study programme use PowerPoint, what intentions do you think they have? [that we should]	Remember the subject matter *(e.g. remember definitions)*	47	28.7
	Understand the subject matter *(e.g. interpret it)*	49	29.7
	Are able to apply the subject matter *(e.g. to solve problems)*	17	10.3
	Analyse the subject matter *(e.g. see connections)*	11	6.7
	Are able to evaluate the subject matter *(e.g. review methods)*	–	–
	Are able to create new understandings based on the subject matter *(e.g. creating new products)*	2	1.2
	Don't know	37	22.4
	Missing	2	1.2
	Total	165	100

Appendix II

AtMP and AtTL subscale-items. Means and standard deviations.
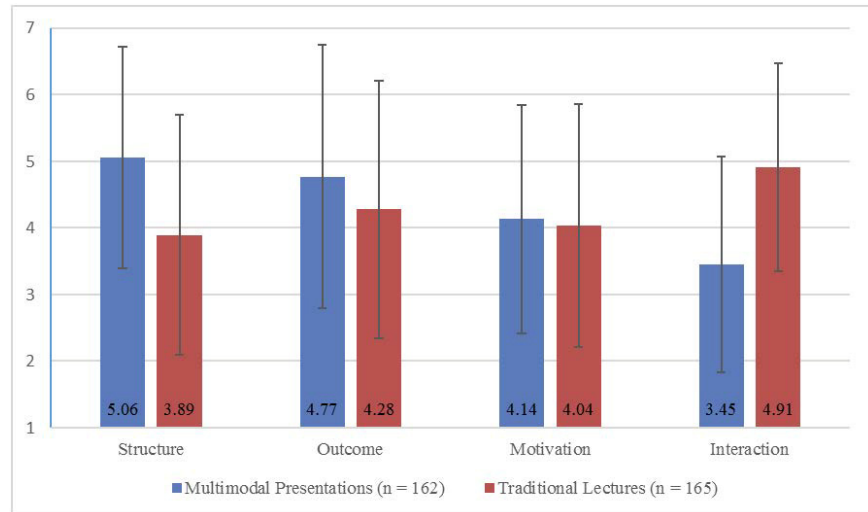
Appendix III

Pearson's Correlations of AtMP, AtTL, Digital Literacy and Didactic Awareness

Measures	1	2	3
1 AtMP			
2 AtTL	−.81 (155)		
3 Digital Literacy	.36 (159)		−.26 (156)
4 Digital Awareness	.49 (161)	−.46 (157)	.33 (161)

Note: *All significant at p < .001, sample size in parentheses.*

Appendix IV

AtMP and AtTL predicted by Digital Literacy

	AtMP [a]		AtTL [b]	
	B	*SE B*	*B*	*SE B*
Constant	2.77	0.50	5.31	0.55
Lecturer Clarity				
Conceptual vs. Factual	0.41	0.27	−0.23	0.30
Don't Know vs. Factual	−0.06	0.29	0.20	0.32
Procedural vs. Factual	0.55	0.31	−0.59	0.35
Preferred Lecture Format				
Medium vs. Low Interaction	−0.74	0.36*	0.86*	0.39
High vs. Low Interaction	−1.11	0.33***	0.84*	0.37
Digital Literacy	0.30	0.11**	−0.14	0.12
Didactic Awareness	0.36	0.07***	−.35***	0.08

Note*: a R2 = .37, F (7, 140) = 11.86*** b R2 = .27, F (7, 137) = 7.34, p****
*p ≤ .05, **p ≤ .01, ***p ≤ .001.

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