

The effect of face-to-face interaction in supporting intrinsic motivation in blended courses

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### **Abstract**

The goal of this research is to examine the influence of face-to-face interaction in supporting intrinsic motivation during blended courses. A 12-week bachelor physics course for mid-career scientist switching to education is studied. Participants (N=11) completed an adjusted version of the Intrinsic Motivation Inventory five times to examine the development of intrinsic motivation during this course. Results show that the intrinsic motivation consistently remains high. Semi-structured interviews were conducted to determine how face-to-face interaction supports students' psychological basic needs based on the Self-Determination Theory. Face-to-face interaction especially supports the feeling of relatedness and competence, because participants prefer to ask questions during the meeting instead of online and appreciate the real-life collaboration with peers and the contact with the lecturer to online forms of cooperation. Literature research about supporting the basic needs in fully online courses indicates that students' feeling of relatedness is fulfilled to a lesser extent than the feeling of competence and autonomy in an online course. This supports the results that face-to-face interaction is an important factor in supporting intrinsic motivation during blended courses.

*Keywords: Intrinsic motivation, Self-Determination Theory, blended learning, online education*

Technological advances in education have led to a trend towards more and more material being offered online. Courses can be either fully online or blended, with online components of the course integrated within the course program (Siemens, Gasevic & Dawson, 2015). For example, a recent US study shows that more and more students enrolled in a fully online course or courses with reduced lecture time and more online delivered content (Kentnor, 2015). While the enrolments in higher education in the US decline, the number of students taking an online course is still growing (Allen & Seaman, 2016). In the Netherlands, research shows that the proportion of face-to-face vocational trainings has declined with eight per cent last three years, while the proportion of courses with online components and fully online courses increased with eight per cent (Tieben, In 't Veld, Van der Ven, 2018). An extreme example of the trend toward more online education is the rise of Massive Open Online Courses (MOOCs). These courses are available for anyone who wants to enrol and exist in almost every domain nowadays. The number of total MOOCs available for registration is still growing and more than eight-hundred universities offer MOOCs at this moment (Shah, 2018). Still more common are the so-called Small Private Online Courses (SPOCs) and blended courses.

This shift of the educational process towards the digital domain brings with it some fundamental questions. One of them has to do with motivation. Is it possible to motivate students online in the same manner and with the same effect as in face-to-face interaction? This is especially important in the field of intrinsic motivation, as this type of motivation is a moderate to strong predictor of performance (Cerasoli, Nicklin and Ford, 2014) but is also notoriously fragile.

Intrinsic motivation leads to more enjoyment, spontaneous interest and exploration and this is considered essential to both cognitive and social development (Ryan & Deci, 2000). Despite the growing trend toward online education and the importance of supporting

students' intrinsic motivation, there is currently limited research about students' intrinsic motivation during blended and online courses. This study aims to contribute to this field.

According to the self-determination theory, the fulfilment of our three innate psychological basic needs – autonomy, relatedness and competence – enhances our intrinsic motivation (Ryan & Deci, 2000). Addressing these needs in courses is therefore of great importance. The trend toward more online education by definition means a decline of the face-to-face interaction. The lack of real-life learner-learner and learner-instructor interaction could conceivably have a negative effect on students' perceived feeling of relatedness and competence. It is therefore hypothesized that face-to-face meetings are necessary to promote students' intrinsic motivation during a course.

For this research the aim is to examine the importance of face-to-face interaction in supporting intrinsic motivation during a blended course. A case study is done to examine how face-to-face interaction supports students' perceived feeling of the three psychological basic needs and to determine the development of students' intrinsic motivation during a blended course. Moreover, in order to get an overview of the literature on students' feeling of autonomy, competence and relatedness in fully online courses a literature survey has been performed.

## **Theoretical Framework**

### **Self-Determination Theory**

The Self-Determination Theory (SDT) (Ryan & Deci, 2000) is one of the major motivation theories that was formulated in the last decades of the 20<sup>th</sup> century. SDT makes a distinction between two main types of motivation, intrinsic and extrinsic motivation. Intrinsic motivation refers to behaviour that is driven by interest, enjoyment or excitement of an activity itself and is seen as the most autonomous kind of motivation. For extrinsic motivation, the

consequences of the activity constitute the drive to perform an activity. The SDT describes different types of extrinsic motivation and these types can be placed along a continuum of perceived autonomy. The least autonomous type of extrinsic motivation refers to behaviour that is purely driven by external stimuli such as demands or rewards, while in the case of the most autonomous types of extrinsic motivation the value of an activity is seen as personally important. A meta-analysis shows that both intrinsic motivation and the most autonomous type of extrinsic motivation are positive related with study achievements, while the other types of motivation are negative related (Taylor et al., 2014). Another meta-analysis shows that intrinsic motivation is not only a moderate to strong predictor of performance in school, but also in work and physical domains (Cerasoli, Nicklin and Ford, 2014). Moreover, intrinsic motivation leads to more enjoyment, spontaneous interest and exploration that is important to both cognitive and social development (Ryan & Deci, 2000).

According to the SDT, the fulfilment of three innate psychological basic needs – autonomy, competence and relatedness – can support intrinsic motivation, whereas a lack of these needs can contribute to a decrease of intrinsic motivation. Learning environments that support students' feeling of autonomy will generally have a positive effect on students' intrinsic motivation. Moreover, if students experience a sense of competence, this can lead to an increase of intrinsic motivation. In general, activities that contribute towards this feeling, like positive feedback or communication, have the effect of enhancing the intrinsic motivation. However, the feelings of competence and autonomy will generally not improve intrinsic motivation when the need for relatedness is unfulfilled (Ryan & Deci, 2000). This means that interaction and connectedness are prime factors in supporting intrinsic motivation.

Despite the trend towards more online education (Deming et al., 2015) and the fact that intrinsic motivation is a strong predictor of performance, little research has been done into supporting intrinsic motivation in blended and online courses.

### **Blended learning**

As this study is concerned with a blended course, it is necessary to agree on a definition of such a course. Both relatively broad and narrow definitions of blended learning can be found in the literature. Verkroost, Meijerink, Lintsen and Veen (2008) formulated, for example, blended learning as: “the total mix of pedagogical methods, using a combination of different learning strategies, both with and without the use of technology” (p. 501). In other studies blended learning is simply defined as a combination of online and real-life learning activities. Chen and Jang (2010) noted that a blended course means that within the course 30 to 80% of the learning activities are delivered online. We adopt this latter, simple definition for this research, because the goal of this research is to examine the value of face-to-face interaction in supporting intrinsic motivation and not the actual design of the course.

### **Online learning**

The definition of online learning taken for this research is that all the learning activities are delivered online and that there are no face-to-face meetings. A general trend toward more online education can be observed and this is confirmed by the increased popularity of Massive Open Online Courses (MOOCs) (Shah, 2018). What defines a MOOC is still relatively unclear. The most common definition of a MOOC is “an online course designed for large numbers of participants, that can be accessed by anyone anywhere as long as they have an internet connection, are open to everyone without entry qualifications, and offer a full/complete course experience online for free” (Jansen & Schuwer, 2015). We adopt this definition for the present study.

### **Research question**

Promoting intrinsic motivation in education is thus highly desirable, because intrinsic motivation is a moderate to strong predictor for performance in any field (Cerasoli, Nicklin and Ford, 2014). The trend towards more online education (Kentnor, 2015) means a decline of real-life contact moments. However, the influence of this trend on students' intrinsic motivation is largely unknown. From SDT, one may hypothesize that students will most probably experience the feeling of relatedness to a lesser extent due to the lack of real-life learner-learner and learner-instructor interaction, but this has not been proven. Moreover, we assume that the reduction of real-life collaboration and learner-instructor interaction could also have a negative effect on students' feeling of competence. At the same time, online and blended courses have a greater accessibility and students get more control over the place, time and pace at which they learn. We suppose that this could lead to a greater feeling of autonomy. Our hypothesis is that, considering this balance, face-to-face interaction is necessary for supporting students' intrinsic motivation. This results in the following research question: What is the effect of face-to-face interaction in supporting intrinsic motivation during a blended course?

In order to answer the research question three sub-questions are formulated:

1. How does intrinsic motivation develop during a blended course?
2. How does face-to-face interaction support the three psychological basic needs in a blended course?
3. What does the literature say about supporting autonomy, competence and relatedness in fully online courses?

The intention was to do comparative research in a blended and online course on the same subject, with the same teacher and using the same online material. However, the online course was not yet available when this research was conducted and, therefore, literature

research was done in order to compare the results on intrinsic motivation in a blended course to the known results on intrinsic motivation in fully online courses and thus to clarify the effect of face-to-face interaction on intrinsic motivation.

## **Methods**

For this research a qualitative case study has been done to examine both the development of intrinsic motivation during a blended course and the influence of face-to-face interaction on participants' perceived feeling of competence, autonomy and relatedness. A mixed-method approach was adopted. Closed-ended questionnaires and semi-structured interviews were conducted. Moreover, literature research about supporting the three psychological basic needs in fully online courses has been done.

### **Setting case study**

To answer the first two sub-questions about the development of intrinsic motivation during a blended course and the influence of the face-to-face interaction on the satisfaction of the three basic needs, research has been done into a 12 week Bachelor physics course on special relativity. This course was offered by the Dutch organisation Natk4all. This organisation provides physics courses at a Bachelor level for mid-career scientist switching to education. For this course biweekly face-to-face meetings were organised and these meetings consisted of a formal and informal part. In the formal part the course lecturer explained new theories, while in the informal part there was time for questions and working on exercises together. Between these sessions students had to watch educational videos, practice with exercises in the online learning environment and read some literature. There was also an online forum available where participants could ask the lecturer questions or discuss with peers about the topic. See figure 1 for an overview of the course.



Week	0	1	2	3	4	5	6	7	8	9	10	11	12	22-23	
<b>Contact</b>															
- Lecture		1		2		3		Christmas holiday		4		5			
- Working session		Assgmt. 2		Assgmt. 4		Assgmt. 6					Assgmt. 8		Assgmt. 10		
<b>Online</b>															
- Videos		Video set 1	Video set 2	Video set 3	Video set 4					Video set 5					
- Assignments		Assignment set 1	Assignment set 3	Assignment set 5	Assignment set 7					Assignment set 9					
- Literature		Literature set 1	Literature set 2	Literature set 3	Literature set 4					Literature set 5					
- Forum/email															
<b>Exam</b>															
<b>Measurements</b>															
- IMI		1		2		3				4		5			
- Interviews															

Figure 1. A schematic overview of the blended course on special relativity

## Participants

Twenty-six academics enrolled in the blended Natk4all course on special relativity. Most of them have already a degree in a related field to physics and aspire to become a physics teacher. Therefore they had to acquire some domain-specific knowledge first. They ranged in age from 23 to 59. Twenty-two academics participated in the final exam, of which nineteen passed the first time. This represents a dropout rate of 15%.

Every meeting between 14-20 students were present and all of them were invited to fill out the closed-ended questionnaires. We had a response rate of hundred per cent per meeting. Five academics were invited for a semi-structured interview, of which four accepted. Two were male and two were female and all of them visited at least four face-to-face meetings.

## Questionnaire

A closed-ended questionnaire, based on the Intrinsic Motivation Inventory (IMI), was used to measure participants' intrinsic motivation. The IMI is in turn based on the Self Determination Theory and consists of seven subscales: interest/enjoyment, perceived competence, effort/importance, value/usefulness, felt pressure/tension, perceived choice and relatedness

(Selfdeterminationtheory.org, 2018). To reduce the time needed to answer the questionnaire, a selection of the subscales was made. This was based on the relevance of the subscales to the course.

Because the fact that almost all participants had to take the course to eliminate their physics deficiencies, the perceived choice subscale would not lead to reliable and meaningful data to answer the research question and was therefore not included in the questionnaire. The relatedness subscale focuses on friendship formation instead of teacher-student or student-student interaction and was therefore also not considered relevant to this research. Lastly the subscale of felt pressure/tension was not included, because this subscale is related to extrinsic motivation. The subscales of interest/enjoyment, perceived competence, effort/importance and value/usefulness were included in the questionnaire. The subscale of interest/enjoyment is the most important one, because this subscale is considered as the self-reported measure of purely intrinsic motivation. The other subscales are also important, as perceived competence is a positive predictor of intrinsic motivation, the subscale effort/importance gives an indication of the amount of work that is being done by the student and the subscale of value/usefulness measure the most autonomous type of extrinsic motivation integrated regulation (Selfdeterminationtheory.org, 2018).

Four items from each subscale were selected from the IMI, because it needed to be constrained in length. Items were translated and were modified slightly to better fit the context (e.g. 'I will describe this activity as very interesting' was modified to 'I will describe this course on special relativity as very interesting'). The questionnaire used a 5-point Likert scale. See the appendix for the questionnaire.

When analysing the data, we decided to delete the translated question 'I think I will not always be able to stay focused during this course' from the subscale interest/enjoyment. The original question from the IMI is 'This activity does not hold my attention at all'. The

translated question emphasise if people are able to hold their attention during the course, while the original question emphasise if the course leads to participants' attention. Moreover, the translated question unintentionally emphasises the words 'not always', while the other questions from the subscale interest/enjoyment can be interpreted as more general questions. Including this question could therefore have a negative effect on the reliability of the results and we chose to leave it out.

### **Reliability questionnaire**

Calculating a reliable Cronbach's alpha for each subscale was impossible with our relatively small available data set. The number of participants and the spreading of the data were insufficient for this purpose. Therefore, we chose to use the validity as measured in another study that employs exactly the same questionnaire. This study showed that that the reliability of the subscales interest/enjoyment ( $\alpha = .794$ ), perceived competence ( $\alpha = .828$ ) and value/usefulness ( $\alpha = .924$ ) were high. The reliability of the subscale effort/importance ( $\alpha = .639$ ) was questionable, but not one specific question in the construct could be indicated to lead to this lower value.

### **Interviews**

The interview protocol included a total of eight planned questions. The goal of these questions was to examine the influence of both the face-to-face meetings and the online learning environment on participants' perceived feeling of competence, autonomy and relatedness. The planned questions about relatedness focused on the teacher-student and student-student interaction during and between the biweekly meetings. The planned question about autonomy examined whether participants think they had enough freedom to work when and where they wanted. See the appendix for the planned questions.

### **Data collection**

Every biweekly face-to-face meeting participant's completed the adjusted version of the IMI to measure the development of their intrinsic motivation during the blended course. They received the questionnaires on paper, because online questionnaires achieve response rates that are much lower than the response rates of paper-based questionnaires (Nulty, 2008). Because the goal was to measure the development of participants' intrinsic motivation, participants were asked to mark the questionnaires with the same unique and identifiable, although anonymous, characteristics every time.

Individual semi-structured interviews took place ten weeks after the courses. The participants were asked to give consent for audio recording.

### **Data analysis questionnaires**

One-way repeated measures ANOVA tests were used to determine whether the value of each subscale differ statistically significant between the five face-to-face meetings. In the case that this test was significant, a pairwise comparisons table was produced to figure out which sessions were significant different from one another. This test cannot deal with missing data and if participants were missing one meeting, they were dropped from the entire analysis. Therefore, the analysis was initially done with the data of participants who visited all the five meetings (N=8).

Before the repeated measures ANOVA test could be used, a normality check on the data performed and it was checked whether the data met the assumption of sphericity. A Shapiro-Wilk test was conducted for each subscale for each meeting to check normality. Normality could be assumed for seventeen from the twenty results ( $p > .05$ ). The Shapiro-Wilk test gave for interest/enjoyment meeting 3 ( $p = .034$ ), interest/enjoyment meeting four ( $p = .037$ ) and value/usefulness meeting one ( $p = .009$ ) significant results. The repeated measures ANOVA test is quite robust to violations of normality and Q-Q plots have therefore

been made of these three situations (Figure 2). These plots showed that there were only some small deviations from a normal distribution. Because this is not a major concern, the repeated measures ANOVA test was still be used.

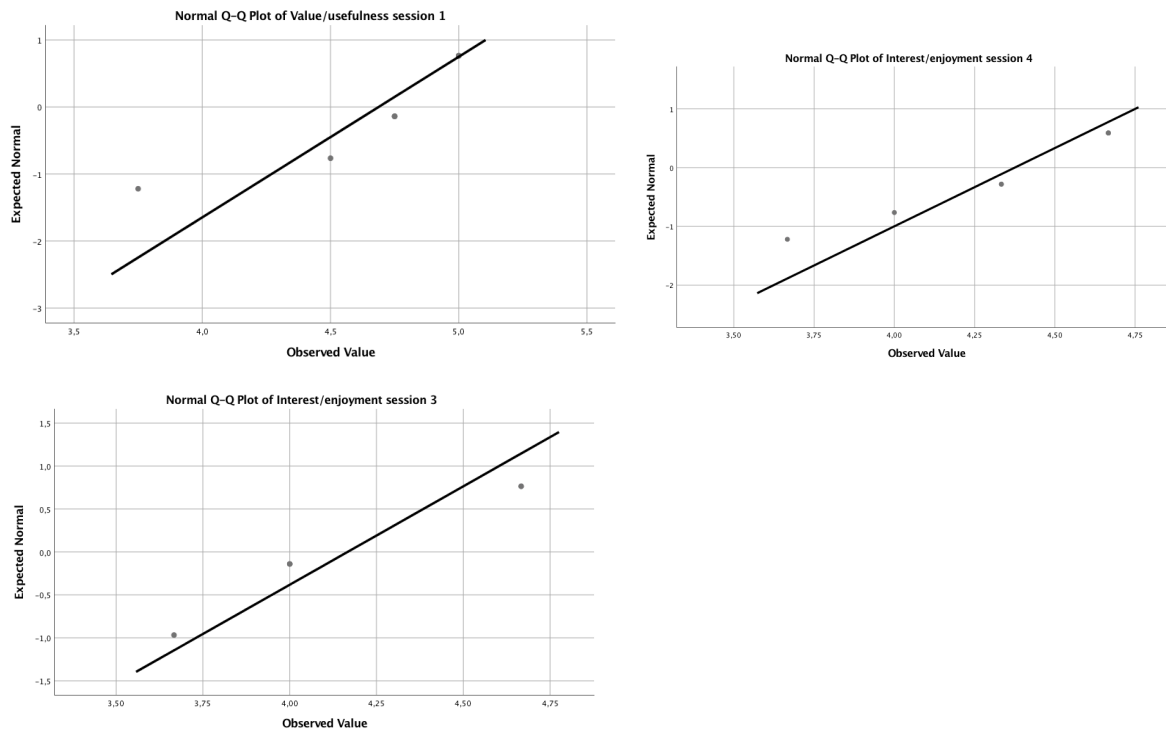


Figure 2. Q-Q plots of the cases that gave significant results with the normality check (N=8)

Mauchly's test was performed for each subscale to test the assumption of sphericity. This test indicated that sphericity could be assumed for the subscale interest/enjoyment and the subscale effort/importance, while the assumption of sphericity had been violated for the subscales perceived competence ( $\chi^2(9) = 0.01, p = .007$ ) and value/usefulness ( $\chi^2(9) = 0.01, p = .008$ ). Therefore the degrees of freedom were corrected using Greenhouse-Geisser estimates of sphericity ( $\epsilon = .387$  for perceived competence,  $\epsilon = .462$  for value/usefulness).

To increase the number of data points, the data of participants who were absent during one single face-to-face meeting were also included in a second analysis. Three participants missed one meeting and, thus, one questionnaire. The value for each subscale for this

questionnaire was estimated by the average of the value of the previous questionnaire and the value of the following questionnaire of this specific participant. For this situation, normality could be assumed for sixteen of the twenty situations, while the Shapiro-Wilk test gave significant results for the constructs value/usefulness meeting 1 ( $p = .009$ ), value/usefulness meeting 2 ( $p = .017$ ), effort/importance meeting 1 ( $p = .046$ ) and effort/importance meeting 5 ( $p = .036$ ). However, Q-Q plots showed no large deviations from a normal distribution (Figure 3).

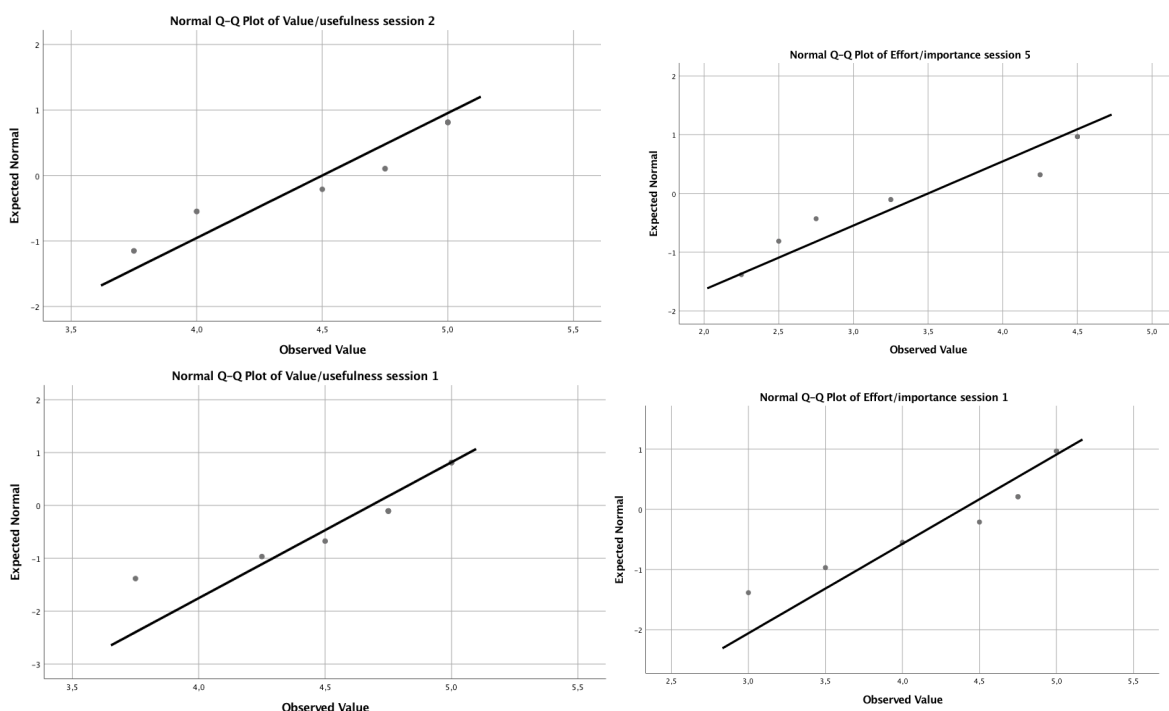


Figure 3. Q-Q plots of the cases that gave significant results with the normality check (N=11)

In this case, Mauchly's test indicated that sphericity could be assumed for the subscales interest/enjoyment and effort/importance, while the assumption of sphericity had been violated for the subscales perceived competence ( $\chi^2(9) = 0.07, p = .009$ ) and value/usefulness ( $\chi^2(9) = 0.02, p < .001$ ). The related Greenhouse-Geisser estimates of sphericity were  $\epsilon = .448$  and  $\epsilon = .458$  for respectively the subscales perceived competence and value/usefulness.

### **Data analysis interviews**

Audio recordings of the interviews were transcribed and the transcripts were coded and categorised. This led to five main categories that describe participants' experiences with all aspects of the blended course. These categories are online forum, peers, perceived freedom in place and time, contact lecturer and the level of the course. Statements about the perceived feeling of competence, autonomy and relatedness were distinguished in each category. Conclusions have been drawn for each category. Two other academics were also asked to draw conclusions from the statements, which led to an inter-rater reliability of 92% and 90%.

### **Literature research**

In order to compare the results on intrinsic motivation in a blended course with known results on intrinsic motivation in fully online courses, Google Scholar was used to search for peer-reviewed literature about intrinsic motivation and the satisfactions of the needs of autonomy, competence and relatedness in fully online courses. Initially, we searched for research of which the title or abstract contained at least one of the terms 'MOOC', 'online course' or 'online education' and one of the terms 'intrinsic motivation' or 'Self-Determination Theory'. Non-English research and research published before 2012 were rejected. This search returned a total of 30 articles.

We wished to include only articles that report about research in a fully online course. Moreover, the article had to report about participants' feeling of autonomy, competence or relatedness during or after the course or the article had to report about a specific component that is related to one of the three basic psychological needs. The titles and abstracts of all 30 articles were examined to determine which articles appeared to meet the inclusion criteria. After this process 11 articles remained. The full text of the remaining articles was read and 7

articles met the inclusion criteria. One article was still rejected (although the conclusion actually supports our hypothesis), as the authors of this article were not completely transparent about their used methods. Finally the reference lists of the most recent included articles were checked. No other articles were found that met the inclusion criteria.

## **Results**

### **Results questionnaires**

Five repeated measures were conducted in order to examine the development of participants' intrinsic motivation, perceived competence and thoughts about the importance and usefulness of the course. Only the data of participants who completed the questionnaire all five times (N=8) and the data of participants who filled in the questionnaire at least four times (N=11) were taken into account. Table 1 includes the mean scores for each subscale and measurement. High mean scores were reported for the subscales interest/enjoyment and value/usefulness, while the means indicated moderately high scores for the subscale effort/importance and moderately scores for the subscale perceived competence.

To determine whether the mean scores of each subscale did differ statistically significant between the five measurements or not, one-way repeated measures ANOVA tests were applied. The results are reported in table 2. The results indicated no significant differences between the values of the five measurements for the three subscales interest/enjoyment, perceived competence and value/usefulness. The levels of the subscale effort/importance differ statistically significant between the five measurements with an effect size of  $\omega^2 = .156$  (N=8) or  $\omega^2 = .187$  (N=11). These values indicate a large effect. With a repeated-measures ANOVA test the best measure of the effect size is omega squared ( $\omega^2$ ) and a  $\omega^2$  of .01, .06 and .14 indicate a small, medium and large effect respectively (Field, 2013).



Table 1

*Mean scores for each subscale per measurement*

Mean (SD)	Interest/ enjoyment		Perceived competence		Effort/ importance		Value/ usefulness	
	N = 8	N = 11	N = 8	N = 11	N = 8	N = 11	N = 8	N = 11
1	4.50 (0.50)	4.49 (0.48)	3.19 (0.73)	3.11 (0.63)	4.25 (0.76)	4.39 (0.67)	4.69 (0.42)	4.68 (0.39)
2	4.33 (0.44)	4.27 (0.53)	3.25 (0.68)	3.20 (0.66)	3.84 (0.46)	3.93 (0.48)	4.47 (0.59)	4.50 (0.52)
3	4.17 (0.44)	4.18 (0.52)	3.10 (0.74)	3.10 (0.63)	3.69 (0.58)	3.77 (0.65)	4.25 (0.52)	4.36 (0.50)
4	4.38 (0.38)	4.31 (0.46)	3.13 (0.52)	3.15 (0.46)	3.38 (0.65)	3.52 (0.76)	4.19 (0.76)	4.34 (0.72)
5	4.42 (0.30)	4.30 (0.51)	3.06 (0.85)	3.09 (0.74)	3.44 (0.86)	3.50 (0.92)	4.44 (0.48)	4.52 (0.47)

Table 2

*Results of one-way repeated measure ANOVA test per subscale*

Subscale	N	df	F	<i>p</i>	Effect size ( $\omega^2$ )
Interest/	N=8	4	0.99	.430	
enjoyment	N=11	4	1.22	.320	
Perceived	N=8	1.55	0.20	0.770	
competence	N=11	1.79	0.139	0.849	
Effort/	N=8	4	5.00	0.004	.156
importance	N=11	4	6.80	<.001	.187
Value/	N=8	1.85	2.00	.177	
usefulness	N=11	1.83	1.70	.212	

The pairwise comparisons test was used to examine which means of the subscale effort/importance differ statistically significant from each other. For N=8 the mean score of measurement 1 was significant higher than the mean score of measurement 4 ( $\rho = .033$ ), while the pairwise comparisons of all other combinations of measurements did not show statistically significant differences ( $\rho > .05$ ). For N=11 the mean score of measurement 1 was significant higher than the mean score of measurement 5 ( $\rho = .015$ ), while no differences were detected of the other combinations of measurements.

## Results interviews

### *Online forum*

One of the planned questions of the interviews was whether the participants had often used the online forum for questions between the face-to-face meetings and if they had the feeling that their questions were sufficiently answered by the course lecturer. Three of the four interviewees very clearly stated that they often waited with asking their questions till the next face-to-face meeting. Various reasons were therefore mentioned.

*Participant 1.* I often had the feeling that the lecturer did not understand what was exactly my question when I used the forum, so I was still without answers to my questions. But it helped me that there was a meeting soon and I could personally ask my questions.

*Participant 3.* In a real-life conversation it is easier to say ‘no this is not what I mean, I mean this and this’ and to ask follow-up questions. When you use the forum you have to wait till the answer of the lecturer, then it is not the answer you expect, you have to send a message again, wait again and so on. It takes a lot of time and therefore I asked my questions during the meetings.

*Participant 3.* I am very visually oriented. Making a drawing really helps me to describe what I do not understand or to understand what the lecturer means. It is much easier whether you can do this in real-life instead of making a drawing, making a picture and post it on a forum. I am not going to do this on a forum.

*Participant 4.* I found it really difficult to describe exactly what I did not understand on a forum. As a result of this, the lectures’ answer was not what I expected.

One interviewee mentioned that he asked more question on the forum than during the face-to-face meetings, because the lecturer had to divide his attention between all students during the meetings. On the forum the lecturer had the possibility to answer a question more deeply and

almost always gave some background information. The interviewees also appreciated the open access of the questions on the forum. They liked it to read the questions of others, which led to a feeling of recognition.

#### *Contact with peers*

When asked about factors that influenced the interviewees' feelings with which they came to the five face-to-face meetings, all interviewees cited that the group had a positive effect on their feeling. All of them clearly mentioned that they found it a pleasant group. Three of the four interviewees mentioned that they appreciated it to practice and discuss the study materials together. For example, following was mentioned.

*Participant 1.* I really appreciated it that we came together and discuss the materials and problems. This was an extra way of learning for me. Using differing learning methods really help me. Therefore I came to a more deeply understanding.

Moreover, the interviews suggest that the participants made a group chat on social media. Especially just before the exam they used it a lot, because they wanted a fast response to their problems.

#### *Contact with lecturer*

The interviewees appreciated the contact with the lecturer and different reasons were therefore cited.

*Participant 4.* The lecturer had a very positive impact on me. I really loved the enthusiasm with which he spoke about the subject. That made me happy.

*Participant 3.* The lecturer did not only speak with people who had questions, but he ensured that he talked to everyone at least one time during the meetings and asked

things like ‘How are you doing?’ I found this really pleasant and it had a positive effect on my motivation. They, were little things, but they helped me.

*Participant 2.* The lecturer tried to answer my questions as good as possible and if I did not understand his answer, he tried to explain it in any other way. I loved it and it made me feel appreciated.

*Participant 1.* The mix of watching videos, working on exercises, the explanation of the lecturer and the contact with the lecturer worked very well for me.

#### *Perceived freedom in place and time*

When asked about the perceived freedom in the place and moments to spent time on the course, all interviewees mentioned that they absolutely experienced enough freedom. All interviewees stated that they were behind schedule due to other courses or their job, but they appreciated that a guideline was available.

#### *Level of the course*

The interview data shed also some light on the degree of difficulty of the course. The interviewees described the course as challenging, but not too hard. They appreciated that different learning strategies were incorporated into the course and using their favourite learning strategies helped them to reach the learning goals.

### **Results literature research**

The search for literature led to six articles that are in conformity with our standards. A summary of the setting, used methods and the main conclusions are reported in table 3.

*Summary of the literature research on intrinsic motivation in online courses*

Research	Setting	N	Methods	Remarks	Conclusion
Durksen et al. (2016)	MOOC about dinosaur paleo-biology	1037	Questionnaire - Autonomy - Competence - Relatedness - Belongings	Developed a probabilistic model to establish the relationship between learners' psychological needs (SDT).	<ul style="list-style-type: none"> <li>- High scores for autonomy and competence.</li> <li>- Moderate scores for relatedness and belongings.</li> <li>- Best fitting model only includes autonomy, competence and relatedness.</li> <li>- The model shows a strong connection between competence and autonomy, while relatedness is separated from these two components.</li> </ul>
Yang (2014)	MOOC named 'Integrating technology for meaningful learning'	56	Repeated questionnaire - Intrinsic motivation - Autonomy - Competence - Relatedness	Participation in the online discussions determined students' final grade for 30% and was therefore mandatory.	<ul style="list-style-type: none"> <li>- Scores for intrinsic motivation (moderate/high), autonomy (low/moderate) and competence (moderate/high) remained constant during the course.</li> <li>- Scores for relatedness (moderate) decrease during the course.</li> <li>- There was a significant relationship between intrinsic motivation and participation in online discussions</li> </ul>
Barak, Watted & Haick (2016)	MOOC about nano-technology	325	Pre- and post questionnaire - Intrinsic motivation - Self-determination - Self-efficacy - Career motivation	Conclusion is based on average value of four types of motivation.	<ul style="list-style-type: none"> <li>- Positive relationship between students' motivation and number of messages posted on forum.</li> <li>- Low motivation gain for students who worked individually, while relatively large motivation gain for students who worked in groups of four or five.</li> </ul>
Li et al. (2014)	Two online courses named 'Numerical analysis' and 'Digital signal processing'	54	Semi-structured interviews	Students watched videos within a small group of four or five.	<ul style="list-style-type: none"> <li>- Students prefer to watch videos in a study group. This has a positive effect on their motivation and led to a more pleasant learning experience.</li> <li>- Students appreciated that they could discuss their understanding of the topic with peers.</li> </ul>
Martin, Kelly & Terry (2018)	MOOC titled Elite Sport Performanc: Psychological Perspectives	143	Post questionnaire - Intrinsic motivation - Perceived choice - Competence - Relatedness	Developed framework for the design of MOOCs based upon the SDT to increase completion rate MOOCs.	<ul style="list-style-type: none"> <li>- Completion rate still only 20%.</li> <li>- High mean scores for intrinsic motivation and perceived choice</li> <li>- Moderate mean scores for perceived competence.</li> <li>- Low mean scores for relatedness.</li> </ul>

Filak & Nicolini (2018)	Fully online and face-to-face courses offered by various universities	240	Questionnaire - Autonomy - Competence - Relatedness - Motivation	Participants were asked to reflect on their most recent online course experience and on a similar face-to-face course. Although we do not fully endorse the used method, we include this article for reasons of completeness.	- Students reported lower levels of perceived competence and relatedness for online course than for face-to-face courses. - No significant differences for autonomy were reported.
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As described in table 3, three studies reported about the scores of participants' perceived feeling of autonomy, competence and relatedness in a fully online course. All three studies reported participants' feeling of competence as moderate or high and two studies reported participants' feeling of autonomy as high. Low to moderate scores for participants' feeling of autonomy were reported in the third study, but this can be explained by the mandatory participation in online discussions (Yang, 2014). However, all three studies reported low or moderate scores for relatedness. The results support our hypothesis that it is hard to fulfil students' need of relatedness in an online course.

Our hypothesis is also supported by four other findings. Firstly, Yang found that students' perceived feeling of relatedness decrease during an online course, while the perceived feeling of autonomy and competence remained constant (Yang, 2014). Secondly, Durksen et al. developed a probabilistic model to establish the relationship between learners' psychological needs and the best fitting model shows a strong connection between autonomy and competence, while relatedness is separated from these components (Durksen et al., 2016). The authors described that this may indicate that the need of relatedness is not fulfilled to the same extent as the needs of autonomy and competence. Thirdly, even if an online course is developed according to the principles of the SDT, low values for participants' feeling of relatedness were reported (Martin, Kelly & Terry, 2018). Finally, students reported

lower levels for their feeling of relatedness in online courses than they did in a face-to-face course (Filak & Nicolini, 2018).

Moreover, two studies indicate that both online and real-life group work has a positive effect on students' general motivation. Barak, Watted and Haick (2016) found relatively large gains in general motivation for participants who worked in online groups of four or five for a project during a MOOC. Li et al. (2014) reported that watching MOOC videos within a small face-to-face group of four or five had a positive effect on students' general motivation.

We also assume that the lack of real-life learner-instructor interaction could have a negative effect on students' feeling of competence. Filak and Nicolini confirmed that students' feeling of competence is met to a lesser extent in an online course than in a face-to-face course (Filak & Nicolini, 2018).

### **Conclusion**

Questionnaires and interviews were performed during a blended physics course and literature research was done to evaluate the importance of face-to-face interaction in supporting intrinsic motivation during courses with an online component. Analyses of the repeated questionnaire show that the mean values for the subscales interest/enjoyment (high), perceived competence (moderate) and value/usefulness (high) did not differ statistically significant between the five measurements, while the mean values for the subscale effort/importance (moderate/high) differed statistically significant between the five measurements with a large effect size of  $\omega^2 = .156$  (N=8) or  $\omega^2 = .187$  (N=11). The value for this subscale decreased during the course and the pairwise comparison test shows that the value of the first measurement was significant higher than the value of the fourth (N=8) or fifth (N=11) measurement. These results indicate that both students' intrinsic motivation, students' most autonomous type of extrinsic motivation and students' perceived competence



remained constant on a moderate or high level during the blended physics course, while the indication of the amount of work done by the students decreased. So, the answer on the first sub-question ‘How does intrinsic motivation develop during a blended course?’ is that students’ intrinsic motivation remains consistently high during this blended course.

The second sub-question concerned the fact how face-to-face interaction supports the three psychological basic needs in a blended course. The interview data reveal that face-to-face interaction positively contributes to students’ feeling of competence. Students preferred to ask their questions during the meetings instead of online, because they found it hard to describe exactly what they did not understand on a forum, they found that the lecturer’ answer did not completely fit their online asked questions or they found visual thinking easier in real-life situations. Moreover, both the face-to-face conversations with the lecturer and the face-to-face collaboration with peers helped to fully understand the course material. Face-to-face interaction also contributes to students’ feeling of relatedness. The data show that both real-life contact with peers as the lecturer positively influence students feeling. Students appreciated that the lecturer always asked how they were doing, valued the lecturers’ enthusiasm during the meetings and described that they experience the group as pleasant. Finally, the interview data suggest that face-to-face meetings do not have a negative effect on students’ feeling of autonomy. The face-to-face meetings did not have a negative influence on students experienced freedom in the place and moments in which they have to spend time on the course. Besides that, students appreciated the availability of different learning sources, as real-life lectures, online learning videos and a textbook, so they could focus on their favourite learning source.

Literature research was done to answer the last sub-question ‘What does the literature say about supporting autonomy, competence and relatedness in fully online courses?’. Although the trend towards more online education, few peer-reviewed literature is available

about supporting the psychological basic needs in online education. The few available articles report moderate to high scores for students' feeling of autonomy and competence. However, the articles indicate that students' feeling of relatedness is fulfilled to a lesser extent than the feeling of competence and autonomy in fully online courses, even if a course is developed according to the principles of the SDT.

With the aid of the sub-questions, the research question 'What is the importance of face-to-face interaction in supporting intrinsic motivation during a blended course?' can be answered. Face-to-face interaction supports students' feeling of competence and relatedness, while by the absence of face-to-face interaction it is hard to fulfil students' need of relatedness. Therefore, it can be concluded that, according to the SDT, face-to-face interaction positively affects students' intrinsic motivation during a blended course.

## **Discussion**

This section starts with a discussion of the limitations of the used approach, used methods and data analyses. We will then give the implications for further research.

### **Limitations**

One of the goals of this research was to determine both the development of intrinsic motivation during a blended course and the importance of face-to-face interaction in supporting the three basic psychological needs. Therefore research was done in one blended physics course and the results were generalised. However, this course was dealt with a specific physics subject, was given by one specific lecturer and had a specific course structure and online learning environment. Moreover, all enrolled students aspired a job as a physics teacher. All these aspects vary across different blended courses and can therefore influence the results. The validity would increase if this study was replicated in another blended course.

The used questionnaire was based on the Intrinsic Motivation Inventory and due to time constraints only four questions for each subscale were selected from the IMI. When analysing the data we decided to delete one question from the subscale interest/enjoyment. Although this subscale is seen as the self-reported measurement of intrinsic motivation and the goal was to measure the intrinsic motivation, this subscale consists of only three questions. The reliability of further research will increase if more questions for the interest/enjoyment subscale will be selected from the IMI.

Besides above design limitations, some data limitations could also be identified. Firstly, the conclusions were based on a small number of participants. Secondly, the one-way repeated measure ANOVA test cannot deal with missing data and, therefore, only the data of participants who missed at most one face-to-face meeting and, thus, one questionnaire were taken into account. The results show that students' intrinsic motivation remains constantly high during the course. It can be reasoned that this result can be partly attributed to the fact that it is more likely that student who visit four or five face-to-face meetings have a higher level of intrinsic motivation. Lastly, all interviewees visited at least four of the five face-to-face meetings. This could influence the value that they attached to the meetings and it is possible that the results about the importance of face-to-face meetings are not valid for all students. Also conducting interviews with participants who visited at most three meetings can increase the validity.

### **Implications**

This research provides some preliminary evidence that face-to-face interaction in a blended course is important in supporting the basic psychological needs, especially the need for relatedness, and, thus, students' intrinsic motivation. Given the trend toward more online education and the importance of supporting intrinsic motivation, further research should

examine the influence of a decline of face-to-face interaction in online education more deeply. In the future, this research can be expanded by the development of a fully online course on the same subject, with the same teacher and using the same online material and a measurement of the development of students' intrinsic motivation and students' perception of the three basic needs in this online course. By comparing the results with the results of the blended course, the influence of face-to-face interaction becomes more clearly. Moreover, it would be important to repeat this research with more participants or with other courses to increase the acceptability of the generalisation of the results.

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## Appendix A: used questionnaire

Stelling	Helemaal niet mee eens	Een beetje oneens	Neutraal	Een beetje eens	Helemaal mee eens
Ik denk veel moeite te gaan hebben met de cursus Speciale Relativiteitstheorie.	1	2	3	4	5
De cursus Speciale Relativiteitstheorie lijkt me erg leuk.	1	2	3	4	5
Ik verwacht dat ik mij tijdens deze cursus niet veel zal inspannen.	1	2	3	4	5
Ik zou de cursus Speciale Relativiteitstheorie als interessant willen omschrijven.	1	2	3	4	5
Ik denk dat ik tijdens de cursus mijn aandacht er niet altijd bij kan houden.	1	2	3	4	5
Ik denk dat de cursus een belangrijke bijdrage zal leveren aan mijn begrip van de Speciale Relativiteitstheorie .	1	2	3	4	5
De cursus Speciale Relativiteitstheorie lijkt mij saai.	1	2	3	4	5
De cursus Speciale Relativiteitstheorie lijkt mij nuttig.	1	2	3	4	5
Ik denk dat ik in vergelijking met andere cursisten deze cursus goed zal kunnen volgen.	1	2	3	4	5
Ik vind het belangrijk om deze cursus goed te volgen.	1	2	3	4	5
Ik denk dat ik erg goed zal zijn in deze cursus.	1	2	3	4	5
Ik voel mij vaardig genoeg om deze cursus te volgen.	1	2	3	4	5
Ik zal niet veel energie in deze cursus stoppen.	1	2	3	4	5
Ik denk dat de cursus nuttig is voor het onderwerp Speciale Relativiteitstheorie .	1	2	3	4	5
Tijdens de cursus zal ik proberen erg mijn best te doen.	1	2	3	4	5
Ik denk dat de cursus mij zou kunnen helpen om de Speciale Relativiteitstheorie te begrijpen.	1	2	3	4	5



## Appendix B: standard questions semi-structured interviews

1. Gedurende deze cursus speciale relativiteitstheorie zijn er natuurlijk vijf bijeenkomsten op vrijdagmiddag geweest. Hoe vaak ben je bij zo'n bijeenkomst geweest?
2. Kwam je iedere keer met hetzelfde gevoel naar de bijeenkomsten of veranderde dit gedurende de cursus?
3. Tussen de bijeenkomsten door ben je, neem ik aan, ook met de cursus bezig geweest. Beïnvloedde dit je stemming als je de volgende keer naar de bijeenkomst kwam? Wat waren factoren hierin?
4. Wat vond je van het algemene niveau van de colleges en de opgaven?
5. Hoe heb je de feedback ervaren tussen de bijeenkomsten door en op de bijeenkomsten?
6. Heb je vaak vragen gesteld tijdens de colleges aan de docent? En had je het gevoel dat de je vragen beantwoord werden?
7. Heb je contact gezocht met de docent tussen de colleges door? Zo ja, hoe?
8. Heb je contact gehad met je medestudenten tijdens het college? En buiten de colleges om?
9. Heb je genoeg vrijheid ervaren in de plaats en tijd van het maken van de opdrachten?