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Document Version

Publisher's PDF, also known as Version of record

Publication date:

2003

[Link to publication in University of Groningen/UMCG research database](#)

Citation for published version (APA):

Ruël, G. C., Nauta, A., & Bastiaans, N. (2003). Free-riding and team performance in project education. s.n.

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Free-riding and team performance in project education

Gwenny Ch. Ruël, Nienke Bastiaans & Aukje Nauta

SOM-theme A: Primary processes within firms

Abstract

Recently, business education programmes have increasingly implemented project education into their curricula as a mean to qualitatively improve student performances. This trend has changed the role of the students and the teachers. However, literature and practical experience have also shown negative side effects of working in teams, resulting in lower group performances. One of the most striking effects is that the working in teams gives some group members the opportunity to free-ride. This paper describes an empirical research on free-riding. It focuses on:

- the influence of the teachers' new roles on free-riding
- the effects of free-riding on team performance and team characteristics

Based on the results presented in this paper, it becomes apparent that project education can be detrimental to team performance. The reason for this is that working in teams can lead to free-riding among some group members on the one hand. On the other hand, the non free-riders seem to lower their effort instead of compensating for the free-riders ('sucker-effect' hypothesis). These behaviours result in an overall lower team performance.

With regard to two tutor roles, which are described as the 'process guard' and the 'professional expert', free-riding seems to occur less likely when the tutor plays more the role of process guard. It occurs more likely when the tutor plays the role of expert.

Keywords: free-riding, tutor roles, team-performance, project education, trust, group satisfaction, learning goals

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Introduction

In their curricula business education programmes have more and more implemented project education (Gijsselaers, Tempelaar, Keizer, Blommaert, Bernard & Kasper, 1995; Milter, Stinson & Gijsselaers, 1998). Project education has changed the role of the students and the teachers. Students have to work actively together in small teams on cases and projects. The idea behind this co-operative learning is that students learn more when they work in a group and that they learn at a higher level. Students learn to use different skills, learn to apply business knowledge and integrate between the core disciplines. In this type of education, teachers are no longer the formal providers of knowledge; they fulfil the role of the students' coach, supporting the students in their learning process.

The basis for this type of learning process has its roots in the so-called constructivist learning approach, as described in educational literature. Verschaffel (1995, p.156) states: "Recently the active and constructive way of learning is emphasized. Students are no passive receivers of knowledge, but build their own knowledge and develop their own skills". A way to reach this is via project education, because "group work empowers students giving them a more active role in their own learning" (Morris & Hayes, 1997, p.1). From social psychology, literature studies also show that working in teams has a positive influence on the quality of performances if some conditions are met (e.g. Steiner, 1972; Harkins, 1987). However, literature and practical experience also suggest negative side effects of working in teams can occur, resulting in lower group performances. The following section discusses this.

Theoretical insights

One of the negative side effects of working in teams is called free-riding (e.g. Latané, Williams and Harkins, 1979; Jones, 1984; Sheppard, 1993, Mulvey & Klein 1998). It results from the possibility for some students to lean on the effort of their co-students

and let the others do the work. This behaviour and its consequences are described in both educational literature (Morris & Hayes, 1997; Moust & Schmidt, 1998) and in social psychological literature (Olson, 1965; Latané, Williams and Harkins, 1979). Within the social psychology domain, empirical research can be found about free-riding, also known as a form of social loafing. Social loafing (Latané, Williams and Harkins, 1979) is a reduction in motivation and effort when individuals work collectively, compared with when they work individually or co-actively (Karau & Williams, 1995). Free-riding occurs when someone wants to profit from the activities of others without making a fair contribution of one's own (Stroebe, Diehl & Abakoumkin, 1996). Therefore, free-riding is a more opportunistic form of social loafing.

In the following text, we will describe the educational and social psychology literature respectively.

An educational perspective on free-riding

Morris and Hayes (1997, p.3) describe free-riding as: “The problem of the non-performing group member who reaps the benefit of the accomplishments of the remaining group members without little or no cost to him/herself.”

This free-riding behaviour is described in educational literature as a concerning development. Moust & Schmidt (1998, p.187) state: “Students who do not prepare them-selves for the meetings and are free-riding with the other group members, have to be called to account for their behaviour. If that does not happen, the process of co-operative learning will stop.” This negative effect of free-riding behaviour seems to be inherent to the system of working in teams. Because of the expected negative side effects, it is astonishing to find so little empirical evidence in educational literature.

A social psychological perspective on free-riding

Free-riding does not necessarily lower the overall group performance, that is if the group performance equals the performance of the best students in that group.

However, the free-riding behaviour of some students can annoy and de-motivate the diligent students in such a way that the overall team performance does get worse. This latter phenomenon is recognised in the social psychology field as the ‘sucker effect’ (Kerr, 1983). Due to a feeling of being exploited by free-riders, one also reduces one’s own effort, because he or she does not want to be seen as a sucker who does all the work for his or her co-students (Mulvey & Klein, 1998).

There are several conditions under which free-riding and the sucker effect are more or less likely to occur. These include the type of task to be performed, the number of students within a team (group size), the type of performance and reward (on an individual or a group basis), the identifiability of the individual contribution and certain group characteristics. In the following, we will describe the conditions under which free-riding is less likely to occur and we will also indicate how they are designed within our curriculum. The conditions are interrelated as can be seen.

- *Type of task*

Based upon Steiner's work, Stroebe, Diehl & Abakoumkin (1996) describe a classification of tasks consisting of three categories:

- Additive tasks, the individual inputs are added together so that the group productivity is determined by the individual contributions of all group members.
- Disjunctive tasks, where group productivity depends solely on the performance of the best group member.
- Conjunctive tasks, where group productivity depends solely on the performance of the worst group member.

Making individual contributions indispensable is a way of making free-riding occur less (Stroebe, Diehl & Abakoumkin, 1996). An additive task, where the input of all members is required, is therefore the best task to avoid free-riding. Besides having an additive task in our curriculum, our tasks are also non-routine, extensive and rather complex.

- *Group size*

Increasing the group size stimulates free-riding behaviour in general, but as Stroebe, Diehl & Abakoumkin (1996, p.42) have indicated this effect disappeared “When

group members were led to believe that their individual output could be monitored”. In our curriculum, we work with small groups consisting of 4 to 6 students.

- *Type of performance and reward*

Stroebe, Diehl & Abakoumkin (1996, p.41) state: “A classic strategy to reduce the temptation to free ride,....., involves the privatisation of the public good. ... In cases of group products, 'privatisation' would imply a change in reward structure that assures that the group product is distributed in shares that are proportional to individual inputs”. In our curriculum we use group-assessments but we have the possibility to individually reward students in one group with two extra credits for very good students and two less credits for bad performing students.

- *Identifiability of the individual contribution*

According to Stroebe, Diehl & Abakoumkin, this is another way of lowering the temptation to free ride. Later research has shown that it is not the identifiability of contributions per se that reduces the temptation to free-ride, but rather the possibility of evaluation that identifiability makes possible (Harkins, 1987).

- *Group characteristics*

Trust has a positive effect on group performance (Dirks, 1999). Therefore we expect that will affect the amount of free-riding behaviour in a group. If group members trust and respect each other, we expect that free-riding will occur less. Social control on the individual group members will motivate each member to conform to group values and norms (Sheppard, 1995, p. 133; Harkins, 1987). Making a fair contribution by each person, trusting each other, and being able to rely on others can be considered as a general norms.

The research model

Figure 1 shows the research model we used for this study. The research model forms a representation of the theoretical concepts we used in our study and the interrelations

(that is in terms of positive or negative correlations) between the concepts as we expect to find them. In the following, we will explain the research model.

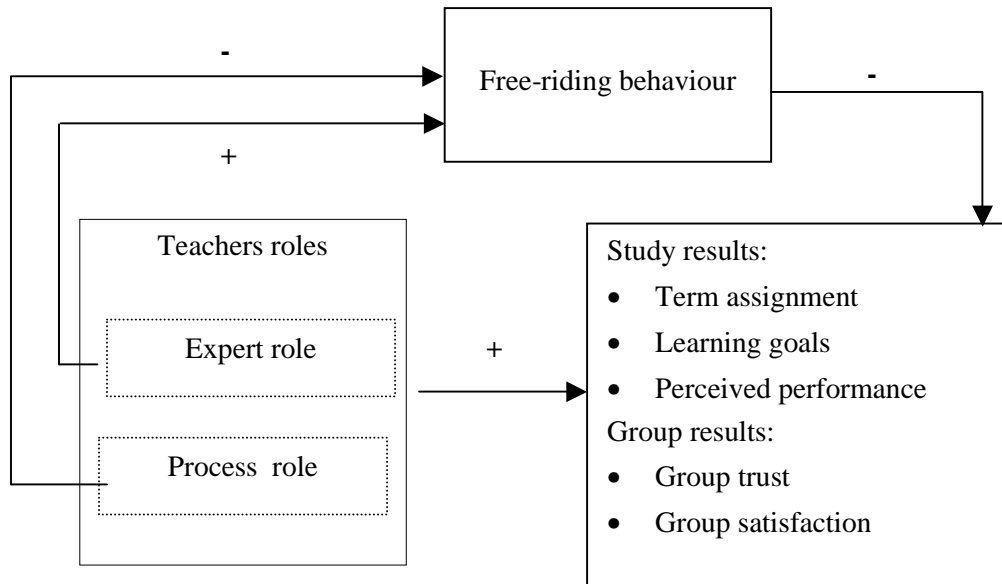


Figure 1: Research model (+/- indicates positive or negative correlations)

Based on former research (Bastiaans & Ruël, 2000) we distinguish two major roles of the tutor, the ‘process guard’ and the ‘professional expert’ and two less explicit roles, ‘being non-directive’ and ‘criticist’. The ‘process guard’ coaches the learning process of the student group, evaluates the group process, sees to it that work plans are made and met, and guards the functioning of the group. In the role of the ‘professional expert’ the tutor uses his/her expertise, for example by showing links between different disciplines or by explaining concepts from literature if necessary. With ‘non-directive’ we refer to the extent in which a tutor gives acting space to the students. A non-directive tutor for example lets the group do the talking, listens well, and leaves initiative for discussion to the group. The tutor in the role of ‘criticist’ is very critical about all the work of the student group, asks stimulating questions, and encourages the group towards more depth.

The study mentioned above showed significant positive correlations between the expert role and process role of a tutor on the one hand and student performance and group results on the other. This means that when a tutor fulfils these two roles, student performance and group results were higher than when the tutor neglected both roles.

We also expect that when free-riding occurs within a group, it will trigger the 'sucker effect' on other group members. This means that they will also lower their effort because they do not want to be (seen as) the sucker who does all the work for the others. This means that free-riding results in a negative effect on the overall student performance and group results.

The study of Morris and Hayes (1997, p.4) suggested, "the free-rider problem may lie, in part, with the failure of the instructor to adequately 'manage' the group process". Some tutors tend to neglect the role of process guide because "the evaluation of group assignments generally focuses on assessing the end product (the group output) rather than the processes students go through, and the skills developed through this learning experience, to achieve output" (Morris and Hayes 1997, p.4). In line with their reasoning we expect the role of 'process guide' to decrease the risk of free-riding (negative correlation).

Taking both the effects of the tutors' roles and free-riding, we expect that the effect of the tutors' roles on student performance and group results will be mediated by free-riding. We expect that the tutors' roles will have a positive relationship with the student performances and group results, but if there is free-riding within a group the student results will drop.

The research has two focuses:

- the effects of free-riding behaviour by students on their team performance and group results
- the influence of the teacher's new roles on free-riding behaviour by students.

The research design

Participants and procedure

This research is carried out among second year students in the Main Phase of the Business Administration programme at the Faculty of Management & Organisation, University of Groningen (The Netherlands). Typical for this programme is its project centred education. The students work together in teams of 12 (in sub-groups of 4) students on projects. A tutor fulfilling the role of a coach guides the students during their work. Typical for a coach is that he/she can fulfil a mix of roles. The tutor guides the learning process, monitors the group process, watches the quality of students' work and assesses the projects.

To measure the different theoretical concepts, we used a questionnaire. The choice for a questionnaire stems from mainly research-economic reasons: many questions were asked to many students in a rather small amount of time. The tutors introduced and distributed the questionnaire among 350 students. The students filled in the questionnaire in their free time and returned the questionnaires to various secretaries of the Business School. As part of a larger study, the students answered questions about perceptions of the various assignments, group functioning, group dynamic characteristics, and team characteristics. The items on the following subjects are relevant for this study:

- the roles of the teachers (9 items on expert role; 6 items on the role of process guard; 7 items on non-directive; 5 items on criticist)
- the perceived structuredness of the task (9 items)
- group dynamic characteristics: trust, group-satisfaction (5 items on trust; 5 items on group satisfaction)
- perceived group performance (4 items)
- perceived free-riding in the group (6 items)
- learning goals (13 items)
- student satisfaction about the functioning of the coach expressed in a grade varying from 1 to 10 (1 item)

The questionnaire consisted of statements. Students could indicate on a five-point Likert scale (varying from 'totally applicable' to 'totally not applicable') to what extent the statement applied to them. Only the student satisfaction on the coach's functioning is expressed in a grade from 1-10. Besides the data gathered from the questionnaires, we also collected the grade (1-10), which student received as a subgroup on their term assignment.

In order to stimulate the response, students who filled in a questionnaire received a small gift. A valid number of 91 (26%) students filled in the questionnaire. Nevertheless as we shall see later on, the 'N' (number of respondents) can somewhat vary over the different analyses and results due to missing data; not every respondent filled in every question.

Results

In a former study (Bastiaans & Ruël, 2000), we used questions about the tutor roles among first year students. Since this was the second time we used the same questions, only this time among second year students, we first examined the reliabilities of the scales (Cronbach's alpha) from this study in comparison with the reliabilities of the scales from the former study. The reasons for calculating the scale reliabilities (see also Cronbach, 1951) are:

- To perform an item analysis to see whether items should be left out
- To present a clearer overview we want to use scales that represent the theoretical constructs (Nunnally, 1978), rather than separate items

The value of Cronbach's alpha (ranging from 0-1) expresses the internal consistency of a scale: the closer the value comes to one, then the more consistent the scale is (see for further reading Cronbach, 1951 and Nunnally, 1978). Table1 shows that the reliabilities of the different scales are good and not that much different from the first time.

Table 1: Results of the reliability analyses (n ~ 90)

	<i>Professional expert</i>	<i>Process Guard</i>	<i>Non-directive</i>	<i>Criticist</i>
<i>Cronbach's Alpha first year</i>	.91	.80	.77	.68
<i>Cronbach's Alpha second year</i>	.81	.83	.74	.70

Because the second year of the Business programme is more content-based and students are supposed to be more independent in their learning than the first year we expect the tutors to fulfil a different mix of roles in the second year than in the first year. We expect tutors in the second year to behave more as a 'professional expert' than the tutors in the first year, since the content has a more prominent role in the second year. We also expect tutors in the second year to behave less as a 'process guard' than the tutors in the first year. This is in line with Vermunt (1992, p. 45) who states, "Learning to learn means a gradual transfer of control over the learning and cognitive processes from the instruction toward the learner himself, a progressive transition from external to internal control. Table 2 presents the results of the paired-samples T-tests, using Student's t as index for the T-tests (SPSS Inc., 1986).

Table 2: T-test on roles (calculated means) in first and second year

	<i>mean 1st year</i>	<i>mean 2nd year</i>	<i>t-value (df ~ 58)</i>	<i>p-value</i>
<i>Professional expert</i>	3.09	3.50	-3.23	.002
<i>Process guard</i>	3.29	2.88	3.75	.000
<i>Non-directive</i>	3.71	3.37	3.40	.001
<i>Criticist</i>	3.27	3.40	-1.30	n.s.
<i>Report mark</i>	6.87	7.09	-1.14	n.s.

As expected, the tutors in the second year acted more as a professional expert than in the first year. According to the students the tutors were also more directive (that is less non-directive) which is surprising considering the fact that students should be more independent and therefore need less directions given by their tutor. Students also indicated that tutors behaved less as a process guard. It is possible that because the second year is more content based, the tutors spent less time as a process guard. Another reason is that because students are supposed to be learners that are more independent, the tutors do not play this role that frequently.

Students also evaluated the functioning of their tutors with a report mark. Table 3 illustrates that students in the second year appreciate all four roles and the role of the 'professional expert' the most. Compared to the findings in the first year it is remarkable that they also value the role of being non-directive in their tutor. It is possible that students have indeed become more independent learners and therefore appreciate the role of being non-directive from their tutor.

Table 3: Correlations between the report mark and the roles of tutors (n ~ 90)

	<i>Professional Expert</i>	<i>Process Guard</i>	<i>Non-directive</i>	<i>Criticist</i>
<i>Report mark (1st year)</i>	.64**	.44**	-.01	.37**
<i>Report mark (2nd year)</i>	.53**	.29**	.23*	.24*

* p < .01; ** p < .001

Analyses on aggregated data

Since a number of our concepts and variables take place at the level of a subgroup, analyses concerning these concepts should also be conducted at subgroup-level. For example, the mark on the term-assignment was a subgroup-mark given to all the individual members (mostly four students) in a subgroup. Free-riding, trust, and

group satisfaction are typical group dynamic variables and should therefore be analysed at group level.

Because we gathered the data on an individual basis, we transformed the data by aggregating the individual data to group data. This is only allowed when the intra-class correlations are sufficiently high (Kenney & La Voie, 1985) indicating that within the group there is consistency with respect to the scores on the variables one wants to aggregate upon. We first calculated the intra-class correlations (see Kenny & La Voie, 1985) as reported in Table 4.

Most of the intra-class correlations (r) are sufficiently high, varying between .45 and .65. Only the intra-class correlation on the scale 'learning goals' is too low (.09) and on the scales 'task structuredness', 'free-riding' and 'non-directive' are rather low (all .16).

This means that individual students of a subgroup seem to agree upon most group characteristics and that it is justified to perform analyses using these aggregated data. The scales 'learning goals', 'task structuredness', and 'non-directive' will be left out in further analyses. Since 'free-riding' is one of our main variables and we are very interested in the results, we will keep this scale in the analyses, but the results should be interpreted with caution.

Table 4: Intraclass correlations based upon ANOVA's with the subgroup per group used as a factor

	MS _{between}	MS _{within}	F	$r = (F-1) / (F+n-1)$
<i>Trust</i>	0,541	0,148	3,659	0,57
<i>Performance</i>	0,532	0,128	4,152	0,61
<i>Learning goals</i>	0,215	0,179	1,203	0,09
<i>Groupsatisfaction</i>	1.023	0,213	4,797	0,65
<i>Taskstructuredness</i>	0,38	0,276	1,374	0,16
<i>Expert</i>	0,434	0,188	2,307	0,40
<i>Procesguard</i>	0,765	0,29	2,638	0,45
<i>Nondirective</i>	0,426	0,308	1,385	0,16
<i>Criticist</i>	0,443	0,156	2,835	0,48
<i>Free-riding</i>	0,38	0,276	1,374	0,16
<i>Mean:</i>				0,37
<i>Standarddeviation</i>				0,21

One of the focuses of this paper was the influence of the different teachers' roles on student performance, group characteristics, and free-riding. Looking at the correlations in Table 5 one can see that most correlations are not significant, suggesting that the tutors' roles have no significant effect on student performance or group characteristics.

Furthermore, as mentioned earlier the scale 'free-riding' was not very consistent over the group. The correlations with 'free-riding' are not significant. The only interesting fact is that the correlation between 'process guard' and 'free-riding' is in the expected direction, suggesting that that free-riding occurs less often when the tutor plays more the role of process guard ($r = -.20$). A process guard is more open to the group processes that evolve, more able to detect signals of free-riding and may put

more effort in preventing free-riding. However, since the correlation is not significant, every conclusion is somewhat speculative.

Table 5: Correlations with roles of the tutors (n=45)

	<i>Free riding</i>	<i>Trust</i>	<i>Group satisfac.</i>	<i>Perfor mance</i>	<i>Term. assignm.</i>
<i>Process guard</i>	-.20	.16	.23	.27*	.12
<i>Prof. Expert</i>	.19	-.02	.06	.03	-.00
<i>Criticist</i>	-.02	.08	-.04	.14	-.08

*p<.10; **p < .001

Note: Because the number of groups is 45, we have used a higher significance level of .10

The second focus of this paper is the influence of free-riding on team-performance. The actual team performance in this study consists of a term-assignment, an extensive paper about a market analysis on which the subgroup worked during the whole term. The tutor evaluates the term-assignment with a group-grade, which is given to every individual of the subgroup. Table 6 shows a negative correlation (-.25) between the term-assignment and free-riding, which means that the more free-riding within a group, the lower the study results. This supports the ‘sucker-effect’ hypothesis that the non free-riders also lower their effort instead of compensating for the free-riders which results in a lower team performance. Not only is the actual performance as expressed in a group-grade, given by the tutor, lower when more free-riding occurs, but also the performance as perceived by the group itself (-.46) is lower when more free-riding occurs. When there is free-riding within a group, the group members are also more dissatisfied with their group (.63). For example they are less happy with the subgroup itself, they like being in the group less, and are less content about the co-operation in the group In the case of free-riding students also trust each other less (-.59): they feel they can trust each other less and can rely less on each others knowledge. So free-riding not only has a negative effect

on student performance, it also has social-emotional consequences such as negative feelings about the group and its members (group results).

Table 6: Correlations with free-riding (n=45)

	<i>Free-riding</i>
<i>Term assignment</i>	-.25*
<i>Perceived performance</i>	-.46***
<i>Trust</i>	-.59***
<i>Groupsatisfaction</i>	-.63***

* $p < .10$; ** $p < .05$; *** $p < .01$

Mediator effect

Our research model (Figure 1) suspects a mediator effect of free-riding. We expect that the tutors' roles have a positive relationship with student performance and group results, but if there is free-riding within a group these student results will drop. In order to test whether free-riding has a mediating effect on student performance, we performed regression analyses with the relevant models, following Baron & Kenny (1986).

In Table 7a, with 'process guide' as the focal independent variable, the following models are tested:

- Model I: regressing the mediator 'free-riding' on the independent variable 'process guide'
- Model II: regressing the dependent variable 'term assignment' on the independent variable 'process guide'
- Model III: regressing the dependent variable 'term assignment' on both the independent variable 'process guide' and on the mediator 'free-riding'

Table 7a: Standardised β -coefficients of the regression analyses (n=45)

	<i>Dependent variable</i>		
	<i>Model I: Free-riding</i>	<i>Model II: Termassignment</i>	<i>Model III: Termassignment</i>
<i>Indepent variable: Process guide</i>	-20	.12	.07
	F(1,43)= 1,87 (n.s.) B = -.28 Std.error = .20	F(1,43)=.62 (n.s.) B=.14 Std.error = .17	F(2,42)= 1,55 (n.s.) B = 0 Std.error = .17
<i>Indepent variable: Free riding</i>			-.24
			F(2,42)= 1,55 (n.s.) B= -.19 Std.error = .13

Model I shows that the more a tutor takes on the role of a ‘process guide’ the less ‘free-riding’ occurs within a group. Although Model II shows a positive relationship between ‘process guide’ and the ‘term assignment’, this effect is less in the third equation, whereas free-riding has a negative relationship with the ‘term assignment’. Although the β -coefficients are low the tests indicate a mediating effect of free-riding.

In Table 7b we used ‘professional expert’ as an independent variable. In the second model however, no relationship was found between ‘professional expert’ and the ‘term assignment’.

In short we can conclude that there is some indication for the existence of a mediating effect of free-riding, but not all that convincing.

Table 7b: Standardised β -coefficients of the regression analyses (n=45)

	<i>dependent variable</i>		
	<i>Model I: Free-riding</i>	<i>Model II: Term assignment</i>	<i>Model III: Term assignment</i>
<i>Indepent. Variable: Prof. expert</i>	.19	-.00	.05
	F(1,43)= 1,58 (n.s.) B = .38 Std.error = .30	F(1,43) = 0 (n.s.) B = 0 Std.error = .25	F(2,42)= 1,49 (n.s.) B = 0 Std.error = .13
<i>Indepent. Variable: Free riding</i>			-.26
			F(2,42)= 1,49 (n.s.) B = -.22 Std.error = .13

Conclusions and discussion

This paper described research on the effects of student groups' characteristics on their team performance. It focused on:

- the effects of free-riding behaviour by students on their team performance;
- the influence of the teachers' new roles on free-riding behaviour by students.

Based on the results presented in this paper, we can conclude that project education can be a threat to team performance. This is because working in teams by students can have a negative side effect, called free-riding. The following text describes the main conclusions of this paper. This text is subdivided into a part on free-riding and student performance and a part on tutor roles and free-riding.

Free-riding and student performance

We found that free-riding in student groups has a negative effect on their team performance. More free-riding within a group seems to lead to lower study results. Having free-riders in a group does not necessarily mean that the overall group performance decreases. If one or more competent others do all the work, then the grade that the group receives is based on the performance of these other competent students. But when the free-riding behaviour of some students de-motivate the other diligent students, then the overall team performance does get worse. This supports the idea, that the non free-riders lower their effort instead of compensating for the free-riders which results in a lower team performance ('sucker-effect' hypothesis).

Furthermore, some 'soft' performances are perceived lower when free-riding occurs: the students are more dissatisfied with their group and trust each other less. The research model suspected a mediator effect of free-riding. Based on regression analyses there is some indication for the existence of a mediating effect of free-riding, but not very convincing.

Tutor roles and free-riding

As expected, the tutors in the second year acted more as a professional expert than in the first year. They showed links between different disciplines, used their expertise and explained when necessary. They were also more directive (that is less non-directive): they talked more, made more decisions and took more initiative. This is surprising considering the fact that students should be more independent and therefore need fewer directions given by their tutor. In earlier research (Bastiaans & Ruël, 2000) we also found that students appreciate a tutor who fulfils a non-directive role, so they learn to go their own way.

We expected tutors to evaluate the group process, to see to it that students made work plans and to guard the functioning of the group (process guard). This happened less in the second year than in the first year. It is possible that because the second year is more content based the tutors spent less time as a process guard. Another explanation is that because students are supposed to be learners, that are more independent, the tutors did not play this role that frequently.

We did not find the expected significant correlation between the tutor's roles and student performance/group characteristics. In earlier research (Bastiaans & Ruël, 2000), we did find significant correlations between the tutor's roles and student performance.

Although the correlation between 'process-guard' and 'free-riding' was not significant, it is at least in the expected direction. Free-riding seems to occur less often when the tutor plays more the role of process guard.

A limitation of this study was the low response (26%) and small sample size (N = 91 respondents, making up 45 groups). A disadvantage of a low response is that the sample may be biased, for example by containing merely groups with low levels of free-riding behaviour. However, because the standard deviation on the free-riding scale was fair (SD = .98), we feel confident that the sample was not too much biased with reference to the main variable of interest. A disadvantage of a small sample-size is that correlations can be merely due to chance and that they will be different when the study is replicated.

In sum, we believe that our results need to be interpreted with cautiousness. A future replication study with a larger sample size is necessary to conclude with more confidence that:

- the role of process guide inhibits free-riding in groups
- free-riding in student groups has a negative effect on their team performance. leading to lower study results
- free-riding has a mediating effect on student performance

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