DOES A FEEDFORWARD APPROACH IMPROVE STUDENTS' ASSIGNMENT GRADES?

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Abstract

The use of a feedforward approach was investigated on an analytical chemistry module in order to improve report grades and overall course marks. A significant difference in report marks was found between the students that had attended a tutorial and those that had not. However, the study raised the issue of student engagement with tutorials, and the factors that determined attendance. In particular, the study highlighted perceptions of fixed intelligence in poorly performing students and their ability to self-regulate and benefit from feedback or feedforward approaches.

Introduction

There is a plethora of literature regarding assessment methods and the means of providing summative feedback (Glover and Brown 2006). However, formative feedback has been overlooked (Rushton 2005) despite having been highlighted as essential for many years (Black and Wiliam 1998). Moreover, feedback is one of the areas with which students are least satisfied (Bedford and Legg 2007). Recently, the NSS (Unistats 2008) showed that nationally only 38% of students, were satisfied with the timing, amount of feedback and clarification of their understanding of the submitted work. These issues have been identified as being critical for assessment as well as the amount of student effort put into the

assignment and their response to the feedback (Gibbs and Simpson 2004-5). Feedback should be a means of promoting deeper learning but students need to utilise the information constructively to close the gap between their actual performance and a reference level (Rushton 2005). Biggs (1998) has stated that students need to self-assess, perceive the gap correctly and be motivated to address it. Furthermore, there is much evidence to support self-regulation being essential for deep learning processes and greater learning from the feedback process (Andrade and Valtcheva 2009; Nicol and Macfarlane-Dick 2006). During my teaching, I have examined the use of peer (PA) and self assessment (SA) with a view to promoting deep learning in students. Research and observation of teaching methods show that a feedforward approach is rarely used other than for dissertations i.e. an approach that aims to improve students' grades prior to submission of assignments rather than be used to improve subsequent assignments.

The issues of timeliness and formativeness of feedback are often not well addressed as many modules have one assessed piece of coursework close to the end of the module. This is marked and returned to students prior to revision periods with the onus being on the students to collect their work. Thus the students have no opportunity to improve their coursework grades. Furthermore the feedback may not help them in their revision as the comments may be specific to that assignment. A module, on which I teach, has four assessed reports over a six week period with the students receiving feedback in between the deadlines. Therefore they should be able to use this feedback in order to improve subsequent assignments (Carless 2007). This is an approach that has been found to be beneficial in improving students attitudes towards their education by changing their learning styles (Szablewski and McComb 2006b). However, the grades, as with other analytical chemistry modules, are very low with the coursework, exam marks and pass rates all being below the school average. Analytical chemistry relies heavily upon problem solving skills

which students find difficult. Thus a feedforward approach was implemented, in addition to the iterative feedback cycle already in place, to improve the coursework grades. After every practical class students had three days to write a draft report before attending an informal drop-in session/tutorial to receive oral feedback and help with specific issues regarding the report prior to submission in the following week i.e. feedforward before summative assessment. The aim was for all students to also receive written feedback from the initial report back before attempting the second report. Dialogue with students has been identified as critical for feedback to be effective (Nicol and Macfarlane-Dick 2006) although others (Furtak and Ruiz-Primo 2008) found that the ideas discussed in class did not correlate with the written assignments. More diversity was seen in the latter therefore the students are not able to put their ideas into a written format. This could be seen in the students' reports; concepts that appeared to be understood by students in the lab did not always relate to the written report. Thus, a feedforward approach was introduced to address this issue.

The aim of this investigation was to determine whether the teaching intervention, i.e. the feedforward tutorials, had benefited the students in terms of assignment grades, and potentially exam marks and the module pass rate. If the assignment grades had improved without a corresponding improvement in exam grades then this may be indicative of surface rather than deep learning.

Study design

Quantitative methods were used to address the research question. Student report marks were analysed for differences between two cohorts following a change in teaching methods. The study was cross-sectional in design; each student contributed a single mark to the data set which enabled many students to be compared. The disadvantage was that the cohorts, and groups within each cohort, may not have been equivalent despite being on the same

degree programme; e.g. different prior knowledge and/or ability, different points in the timetable may have affected the report submission due to conflicts with other modules and also differing personal circumstances for students. A longitudinal study could have been used but this would require comparison of marks from all lecturers and as there had been a change in teaching staff over the previous two years the two data sets may not be reliably compared. There were also a large number of students that did not submit all reports so a complete data set could not be obtained. Furthermore, students may not attend all tutorials due to time constraints or preferences for particular lecturers. Thus, the most appropriate study design was comparison of two cohorts of students that had participated in a practical where I marked all the reports and had an accurate record of tutorial attendance for the second cohort.

The use of a quantitative approach is advantageous in that it analyses readily available data and gives a definitive answer for the research question based upon the evidence obtained. However, the research design does not allow for differences in the two cohorts prior to the start of the study. Clearly, the cohorts may have a different level of prior knowledge which will affect their grades, the two cohorts might also contain different types of learners and this was not identified. In order to answer these questions further work would need to be undertaken to assess knowledge at the start of the module and identify learner type (BouJaoude *et al.*, 2004). I am aware of students with disabilities in each cohort but these have not been removed from the data set as the aim was to look for trends in improvement of an entire cohort without considering complications from any specific difficulties that may exist.

Ethical consideration

Students were recruited to the study via registration on the module in two consecutive years

(cohort 1: *n* = 86; cohort 2: *n* = 64). The cohorts were split into randomised practical groups (*n* = 6 for cohort 1; *n* = 5 for cohort 2). The students in both cohorts were following the timetable that had been implemented by the module leader and were not disadvantaged for the purposes of this study. The students were not made aware of this investigation prior to attendance in order to avoid bias in participation due to a perceived monitoring of attendance for motives other than this study. Hence, students in the cohort 2 were informed of this study upon departure from the tutorials and permission for recording attendance was granted after an explanation of the purpose and assurance that it would not affect their report grades. The entire cohorts were emailed after all data had been collected and any student, regardless of attendance, was able to have their data withdrawn if they wished. However, no students chose to have their data withdrawn. The data has been presented in such a manner as to ensure student anonymity.

Practical schedules

Cohort 1 was split six groups. Each group attended the four practical and two self-study sessions over a six week period. The timing of each session varied according to the group. Due to the rota design, it was possible that some students submitted two reports before receiving any feedback whilst others received feedback after the first one. However, the thin layer chromatography (TLC) practical, which is being examined in this paper, comes after the self-study sessions so the students should have received all the feedback that was due at that point which is summarised in Table 1. Furthermore some students were on the self-study sessions for the first two weeks and did not submit a practical report until week 4 i.e. group 5 in cohort 1 which may have motivational and time implications as students are less likely to be overloaded at the start of the semester.

<insert Table 1 here>

In cohort 2 the schedule was modified to ensure that all students had received written feedback prior to submitting a second report as well as the feedforward opportunities. Thus the cohort was split into five groups, and the four practicals and only one self-study session took place over a six week rota with a break after week 1 as indicated in Table 1. Two groups of students did the TLC practical in week 1 and the tutorial was extended to allow adequate time for all students. The changes ensured that all students received feedback after the first report as well as the feedforward given at the tutorial prior to the report submission.

Data collection

Student marks (maximum 25) were recorded as required by the module leader for collation of module marks. However, some students had not submitted TLC reports; 25% in cohort 1 and 27% in cohort 2. These students were excluded from the TLC report marks but included in the overall report marks (cohort 1: n = 82; cohort 2: n = 58) as it is likely that many of the students for whom I gave a TLC report mark did not submit at least one of the other assignments. Therefore the TLC report data set for cohort 1 consisted of 60 marked reports split into six groups (n = 5-13) and 43 marked scripts for cohort 2 split into four groups (n = 7-19). The large variation in group size in the cohort 2 is due to two groups being combined in week 1. Cohort 2 was advised to come to the tutorials although attendance was voluntary. TLC reports were collected one week after the practical, marked and returned to the students. Exam marks were also examined but students with a zero mark, possibly for non-attendance, were removed from the data set (cohort 1: n = 71; cohort 2: n = 52).

Data analysis

SPSS v 14.0 was used for all statistical analyses. The TLC report marks data set was analysed for normal distribution using the Levene statistic and did not meet this criteria, due to the small group sizes. Furthermore, due to the non-normality, non-parametric tests were employed to analyse for differences between cohorts or groups of students; Mann-Whitney U test for two independent sets and the Kruskal-Wallis test for more than two independent sets.

Results and discussion

<insert table 2 here>

Comparison of data for both cohorts (Table 2) shows that the mean TLC report mark was higher in cohort 2 but the standard deviation and variance is higher than in cohort 1. Therefore, the median mark is a more robust measure and this is also higher in cohort 2. Whilst a graph of the means showed little difference, the boxplot showing the median values clearly shows that there is a greater difference between the two cohorts (Figure 1). The larger variance for cohort 2 suggests that the whole cohort had not improved by the same amount which may be due to the difference between those attending tutorials and those that did not. The cohorts were statistically examined and showed a weak significant difference between the two cohorts (p = 0.048).

<insert figure 1 here>

Analysis of differences between the groups within each cohort showed a significant difference for the groups within cohort 2 (p = 0.032) whereas there was no difference between the groups within cohort 1 (p = 0.212). The cohorts were examined for correlations of their marks with the number of feedback or feedforward opportunities and none was

found although the spread of data may have hidden any effect (Figure 2). In the case of written feedback only, the Pearson correlation gave p = 0.192 in cohort 2 which was an improvement on cohort 1 which gave p = 0.906. However, this is the maximum number of opportunities available and the extent to which students submitted previous reports or attended the previous feedforward sessions is not known. For cohort 1, groups 1-3 would be expected to give a similar spread of results as no written feedback had been received whilst groups 4-6 may show some improvement if the feedback had been beneficial. In cohort 2 the median marks have increased towards the end of the practical rota which is indicative of the feedforward sessions being beneficial as found by the statistical analysis.

<insert figure 2 here>

Comparison of cohort 2 by tutorial attendance (Figure 3) does show that the mean and the median was higher for those attending the tutorials but the boxplot is, again, a better indicator of the difference. Clearly there were some good results in the group of students that did not attend the tutorials but all of the lowest marks were also in this set whilst the majority of the tutorial attendees had marks of greater than 15 out of 25. There was a highly significant difference (p = 0.001) for tutorial attendance *vs* non-attendance which is an excellent outcome of the teaching intervention if no other factors were involved.

<insert figure 3 here>

Comparison of the frequency distributions (data not shown to ensure student anonymity) showed that students that did not attend tutorials seem to be split into two groups; those achieving <12 or >12 on the TLC report whilst those that attended tutorials had a near-normal distribution. This suggests that the poorly performing students must be targeted for tutorial attendance in order to improve their grades. Research has shown that the more capable students are better able to act upon feedback than the less capable students who also tend to also be less motivated and less likely to attend the tutorial (Sinclair and Cleland

2007). Thus students at the top end of the scale showed a more marked improvement than those at the lower end of the scale. Students with a fixed view of their intelligence will interpret low grades as low ability and give up whilst those with a more flexible view will put in more effort to achieve higher grades (Yorke and Knight 2004). This explains why some students are not good at self-regulation and the reasons for not attending tutorials. This perception of fixed intelligence needs to be changed amongst the students.

In cohort 2 the marks for the individual TLC report sections were also recorded and statistical analysis shows that the most significant improvement was in the methods and results/discussion sections (Table 3). The introduction showed some improvement and the conclusion was the least improved. Therefore feedback needs to focus on these sections. It is particularly gratifying to see that the students are learning to analyse their data as shown by the results/discussion section improvement.

<insert table 3 here>

The medians for reports and exam marks were all very similar between the two cohorts (Table 4). This implies that other report marks may have been lower in cohort 2 as the TLC report marks had improved. However, the cohort 2 coursework mark (data not shown) includes another tutorial component and showed little difference to the overall reports mark. For cohort 1 the only coursework component was the reports so there is a complicating factor for the cohort 2 improvements as the tutorials specifically target problem solving and this may have aided improvement of the results/discussion section. Unsurprisingly the TLC report marks correlated well with the overall report marks, and coursework in cohort 2, as well as the exam mark (p = < 0.001). The lack of improvement in the exam and coursework marks implies that the report tutorials only addressed surface learning for improved report grades. Sellers (2006) also showed no improvement in marks but feedback revealed that students did have a better learning experience and engage more. Carillo-de-la-Pena et al.

(2009) found that students that did not participate in formative assessments did not do well in the exams which corroborates the results found during this study.

<insert table 4 here>

Examination of the coursework results showed that the lowest scoring 22 students , i.e. those achieving <38%, did not attend the TLC tutorial and many did not submit the report showing that missing key coursework components had severely affected their overall results. Furthermore the top four students had all attended the TLC tutorial. It is an extra time commitment for students and it's possible that the poorer performing students did not come due to feeling overloaded. Informal feedback from students revealed that they do not think it is worthwhile attending a tutorial for an extra 2-3 marks (out of 25). However, this equates to 8-12% increase which could be the difference between a pass or a fail. Students do not recognise that it is not just report grades that matter but obtaining a deeper understanding of the material. It has been found that students focus on the marks achieved and not on the lecturers comments (Freake 2006) but that students are more likely to read and act upon the comments if there are no marks identified (Black and Wiliam 1998; Mills et al. 2005).

As discussed earlier many researchers have identified self-assessment as a key issue in students achievement (Andrade and Valtcheva 2009). Initially, students need to know the criteria to be met and then receive regular, prompt feedback in order to develop this skill. These issues are being addressed in this module via the tutorials and written feedback. However, the extent to which students made use of these was limited, as anticipated. Research has shown that some students do not view oral comments, either in the lab or lectures, as feedback (Glover et al. 2004) and many claim not to have received any feedback at all. Whilst other research has shown that students engage well with personal dialogue (Parry et al. 2008). Students have identified interpretation of lecturers' comments

as an issue in written feedback (Bedford and Legg 2007; Glover and Brown 2006). This may be due to a discrepancy between what the students expect and what they get. Very few students act upon feedback as the comments did not have much potential to feedforward for future assignments. Thus Freake (2006) felt that there was need for staff development in providing appropriate feedback. However, other researchers have found that students find the written feedback useful for explaining marks, developing problem solving and analysis skills, and motivating them to succeed in future assignments (Szablewski and McComb 2006a). It is clear from this study, and the earlier discussion, that the poorest performing students need to be targeted to overcome their perceptions of their ability and to enable them to learn to self-assess and therefore become independent learners.

Yorke (1998) has argued that the move towards modular degrees has resulted in the bigger picture being missed from both formative assessment, and indeed, summative assessment. This issue is clearly seen in many modules on which I teach. Students fail to link modules together or effectively use prior knowledge. This is an issue that we are attempting to address on this module via the use of additional tutorials to revise some aspects from the previous years as well as introducing new material. Students should be able to write a reasonable report by the end of level 1 yet appear to start level 2 without this skill. Knowledge at the start of course has been identified as a major issue (Haigh 2006) which was addressed by a change in timing of module events that may be applicable for this module.

Future improvements

Much of our time is spent in correcting grammatical and structural errors in reports even though students receive specific instructions on the format. Technology has been used in both formative and summative ways for improving the structure and content of reports

(Landauer et al. 2009; Jordan 2006) and this could be a more efficient use of lecturers' time. Furthermore, computer aided assessment has been found to be beneficial to encouraging students to become more independent learners (Price 2006).

The only way to ensure that students receive their last piece of feedback before starting the next report is to have the practicals every fortnight rather than weekly. However, this implies that the written feedback is effective which wasn't seen in cohort 2. Another approach would be to use peer assessment rather than the current informal tutorials. Topping (2009) used peer assessment in pairs or small response groups and found that students wrote a much better draft and final report when it was to be seen by their peers rather than just by the lecturer. However, he matched the students in terms of ability whereas other studies have shown that mixed ability groups work better as the weak students improve more than when working with another weak student (Cooper et al. 2008). The strong students are not pulled down but benefit from explaining concepts to the weaker students. Mills and Glover (2006) used a similar approach with peer assessment and self assessment of group reports and the student satisfaction with all aspects was generally high (>70%). However it is essential to have diverse groups and ensure that all students are included in the learning activity. Engagement with the process was better when the emphasis was on feedback and not grades (Mills et al. 2005). It was noted that some students had a perception of doing the lecturers role and implied that they were paying for an education that they were not receiving. This leads to the issue of students' expectations and that a university degree is about providing a range of learning experiences in order to gain a good qualification with a range of transferable skills that can be used throughout their lives. Furthermore, group work encourages the development of learning communities which aids development as independent learners.

Conclusion

A feedforward approach was used to improve students' grades and showed some limited benefit within the cohorts examined. Further analysis of subsequent years may reveal a more significant improvement in report marks and higher order cognitive skills. However, attendance at the tutorials appears to be the biggest hurdle to overcome especially amongst the poorer performing students. Thus the issues of fixed intelligence and self-regulation are the issues that need to be addressed in the HE sector if students are to benefit from feedback or feedforward approaches.

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Table 1 The maximum number of reports and feedback/forward opportunities prior to submitting the TLC report for both cohorts and tutorial attendance for cohort 2 (blank cells indicate that no practical took place)

Week	cohort 1		cohort 2			
	Reports submitted	Feedback received	Reports submitted	Feedback received	Feedforward opportunities	Tutorial attendance
1	0	0	0	0	1	4 of 19
2	0	0	-	-	-	-
3	0	0	1	1	2	4 of 12
4	1	1	2	1	3	4 of 10
5	2	2	2	2	3	3 of 7
6	3	3	-	-	-	-

Table 2 Statistics for the TLC report marks (marked out of 25) of the two cohorts sub-divided by practical group

Cohort / Group	Mean	*N*	Std. Deviation	Median	Minimum	Maximum	Range	Variance
cohort 1								
1	12.5	13	2.8	12.0	8	17	9	8.1
2	14.4	10	2.2	14.5	11	18	7	4.9
3	12.7	12	3.8	12.0	8	20	12	14.2
4	16.7	12	5.3	16.0	8	24	16	28.0
5	13.8	5	3.6	12.0	10	19	9	13.2
6	12.5	8	4.4	13.5	5	17	12	19.7
Total	13.8	60	4.0	13.0	5	24	19	16.1
cohort 2								
1	14.4	19	5.1	16.0	6	22	16	26.1
3	12.0	9	5.3	14.0	3	19	16	28.5
4	18.8	9	3.4	19.0	12	23	11	11.9
5	17.2	6	6.2	18.5	6	24	18	39.0
Total	15.2	43	5.4	17.0	3	24	21	29.3

Table 3 Kruskal-Wallis statistics for the report section marks between groups of cohort 2

Test statistics	Total mark	introduction	method	Results/discussion	conclusion
Chi-Square	8.789	9.503	11.531	11.707	2.685
df	3	3	3	3	3
Asymp. Sig.	.032	.023	.009	.008	.443

Table 4 Overall report (%) and exam marks (%) for both cohorts

Cohort / component	Mean	*N*	Std. Deviation	Median	Minimum	Maximum	Range	Variance
Cohort 1								
All reports	50	82	19	53	7	90	83	371
exam	38	71	18	32	5	81	76	332
Cohort 2								
All reports	47	58	24	51	3	85	83	570
exam	31	52	14	31	2	52	50	183

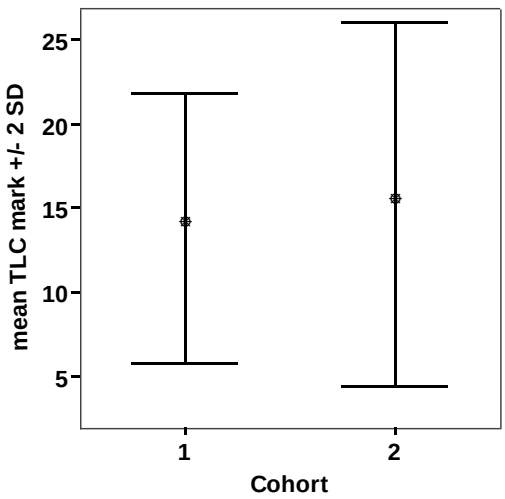
Figure captions

Figure 1 Mean (left) and median (right) TLC report marks (out of 25) for the two cohorts.

Figure 2 Median TLC report marks (out of 25) for cohort 1 (left) and 2 (right) subdivided by group

Figure 3 Comparison of the mean (left) and median (right) TLC report marks (out of 25) for cohort 2 split into the group that attended the TLC tutorial and those that did not attend

Figure 1


mean TLC mark +/- 2 SD
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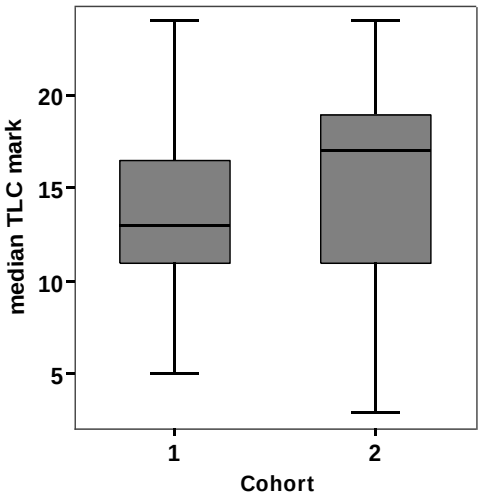
Cohort


median TLC mark
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1
2
Cohort

Figure 2

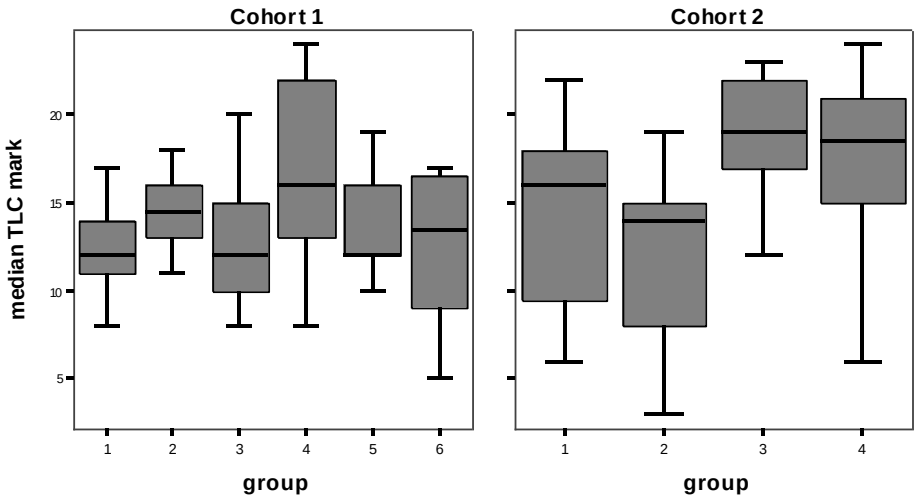
Cohort 1
Cohort 2
median TLC mark
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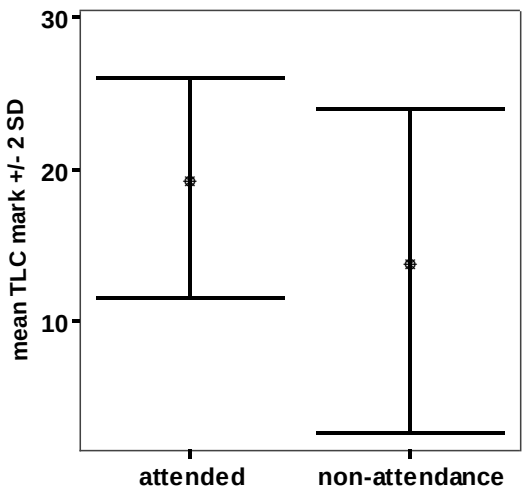
Figure 3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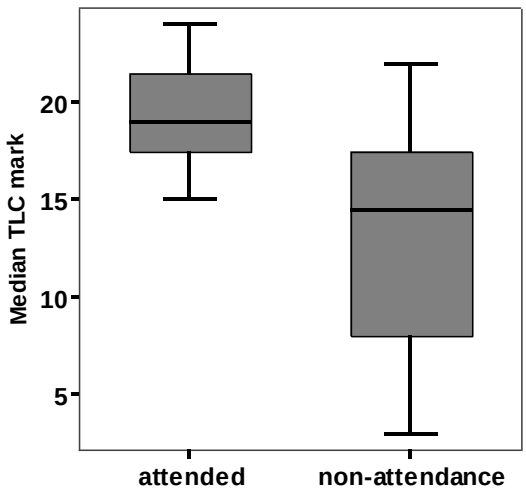
mean TLC mark +/- 2 SD
attended
non-attendance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Median TLC mark
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