Blended vis-à-vis Face-to-Face Courses: The Effect of Delivery Mode on Adult Learners' Performance

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The Asian Conference on Education 2017
Official Conference Proceedings

Abstract
Blended courses, which combine online and face-to-face delivery, are rapidly gaining traction in educational institutions in recent years because of the many benefits they offer. This study provides insights on determinants that affect learners' performance for blended vis-à-vis face-to-face delivery mode across semesters in the Singapore University of Social Sciences (SUSS, formerly known as SIM University or UniSIM). It also illustrates the application of learning analytics in a learning environment catered mainly to working adults. The findings clearly indicated that there is no optimal course design as the appropriate design varies depending on the nature, level, discipline and coursework component of the course. Universities can consider these determinants when designing their courses to maximise the benefits of both blended and face-to-face courses.

Keywords: blended learning, course design, learning analytics, data mining

Introduction

Blended courses that combine both online and face-to-face learning attempt to capture the unique benefits of online and face-to-face courses. Higher success rate and lower withdrawal rate are just two of the key benefits observed in blended courses in comparison to face-to-face and online courses (Moskal et al., 2013). Many early studies on blended courses focused on the various methods of teaching and the introduction of innovations (López-Pérez et al., 2011). Only a few research studies examine the determinants that impact the performance of learners in blended courses. This study aims to bridge this gap in the literature.

In particular, this study examines course determinants such as the course discipline (e.g., accountancy, finance, sociology…etc), nature (i.e., qualitative, quantitative or mixed), assessment method (e.g., written examination or project) and level (i.e., beginner, intermediate or advanced). Analysis is performed at a course level for both blended and face-to-face courses offered in Singapore University of Social Sciences (SUSS, formerly known as SIM University or UniSIM) from 2014 to 2016. SUSS is a university that caters primarily to working adults, and has a mission to provide lifelong education that equips learners to serve society.

The variable of interest is the average final score of learners. The effect of time (i.e., whether determinants of academic performance change over time) is also investigated. Data mining techniques such as decision trees and logistics regression are used to perform the analysis.

This study can provide additional insights to the current literature as it focuses on determinants that affect learners' performance for blended vis-à-vis face-to-face delivery mode across time. It also discusses the improvement that blended courses had brought about in the learning outcomes of learners. With a better understanding of the determinants, universities can better structure their courses to exploit the benefits of both blended and face-to-face courses.

The remaining sections discuss the relevant literature, the methods and analysis used in the study, recommendations for the design of courses based on the research findings, and suggestions for future research.

Literature Review

This review of literature examines prior studies in two areas: the benefits and challenges that blended courses have brought about, and the improvement that blended courses have contributed to learning outcomes.

Vaughan (2007) discussed the benefits and challenges of blended courses based on the views gathered from learners, faculty and administration who had direct experience with this mode of delivery. Both learners and faculty mentioned that time flexibility was one of the key benefits of blended courses. Smyth et al. (2012) reported that learners were able to manage the pace and location of their learning better. Also, faculty were able to make better use of time and technology to resolve course problems and develop new learning activities (Garham & Kaleta, 2002). Higher success rate and lower withdrawal rate were observed in comparison to face-

to-face courses (López-Pérez et al., 2011). Faculty interaction and engagement with learners were also enhanced and this could be due to the creation of online communities (Aycock et al., 2002). Blended courses benefits not only the learners but the institutions as well. For example, reduction in class time brought about a decrease in space requirements, which in turn helped institutions lower their rental expenses (Young, 2002).

Despite the benefits listed above, blended courses are not without challenges. Learners new to blended courses often have the misconceived impression that fewer classes mean a lighter workload (Aycock et al., 2002). Also, blended courses require the learners to take on a more active learning role as compared to face-to-face courses and they may not be prepared to take on this new role (Vaughan, 2007). In addition, faculty may need to spend more time to plan and develop a blended course – it has been suggested that the amount of time taken to plan and develop a large enrolment and blended course is two to three times more than a similar face-to-face course (Johnson, 2002). New skills may also need to be acquired by faculty to facilitate online learning (Voos, 2003).

In view of the benefits and challenges, blended courses are not about delivering the same content in a new mode (Garrison & Kanuka, 2004). There is no best blended course design that suits all courses; the appropriate design varies depending on the nature and discipline of the course, the students, the instructor and the technology available (Garrison & Vaughan, 2008). In this study, the nature and discipline of the course are examined alongside with the other variables mentioned earlier.

Melton et al.'s (2009) study showed that learners taking a traditional general health course via the blended mode generally had higher satisfaction and better grades as compared to learners taking it via the face-to-face mode. In the study, learners were given the choice to select the course mode (i.e., blended or face-to-face). The blended mode comprised two parts: the in-class part that was structured around activities and the online part that was content based. Face-to-face courses were delivered through lectures with the instructor serving as the disseminator of knowledge. The learners enrolled in face-to-face courses did not have access to online information, as contrasted with their counterparts in the blended courses.

Melton et al. (2009) found two benefits associated with the blended courses. However, it could be argued that the finding of higher satisfaction and better grades might be due to the variation in information provided. In this study, learners do not select the mode of course delivery as only one mode is available for each course. This might eliminate the self-selection effect to ensure fairer comparison of the two modes of delivery. Courses delivered through the blended mode comprise three face-to-face seminars and the course content are delivered online. Courses delivered through the face-to-face mode comprise six face-to-face seminars. This helps to ensure consistency in the information disseminated to the learners.

Method

In this study, the final grade distributions of 2527 courses were obtained from January 2014 to December 2016, a total of 6 semesters. Only undergraduate courses in SUSS with at least 5 learners were included. An average grade based on the final grade distribution of the learners was computed for each course. This average grade was further grouped into 2 categories: courses with an average grade falling within the second class honours classification and above (termed as "Better") and courses with a lower average grade (termed as "Average"). This variable "Class" comprised the variable of interest.

Of the 2527 courses included in the study, 1462 courses were classified as "Better" and the remaining 1065 courses "Average".

A total of nine variables was used as inputs (i.e., independent variables) in this study: the school offering the course, the semester the course was offered, course discipline, course level, mode of final assessment, weightage of the final assessment in the final grade, qualitative flag, quantitative flag and course delivery mode. Details of the variables are provided in Table 1. These factors are evaluated with respect to the performance of the learners. Descriptive statistics of the courses are summarised in Table 2.

Table 1. Variables used to evaluate the performance of learners at a course level

Variable Name	Description	Possible Values	Role
Class	Average performance of learners in the course	Better, Average	Target
School	School that offers the course	School 1 that offers mainly social services courses (Sch1)	Input
		School 2 that offers mainly social sciences courses (Sch2)	
		School 3 that offers mainly business courses (Sch3)	
		School 4 that offers mainly technology courses (Sch4)	
Sem	Semester that the course was offered	"1" for January 2014, "2" for July 2014, ..., "6" for July 2016	Input
Discipline	Discipline that the course belongs to	Disc1, Disc2, ..., Disc32 (e.g., Accountancy, Counselling, Electronics...)	Input
Level	Course level	1, 2, 3, 4 (from introductory to advanced)	Input
ExamMode	Mode of final assessment	Written examination or Project	Input
Weightage	Weightage of the final assessment to the final grade	Low or High	Input
Qualitative	Whether the course is qualitative in nature	"1" for "yes", "0" for "no"	Input
Quantitative	Whether the course is quantitative in nature	"1" for "yes", "0" for "no"	Input
CourseMode	Delivery mode of the course	Blended, Face-to-Face (F2F)	Input
CourseCode	Course code	BUS100, ACC101, CLS107 etc	Identifier

Note: Sensitive information had been masked in compliance with confidentiality requirements.

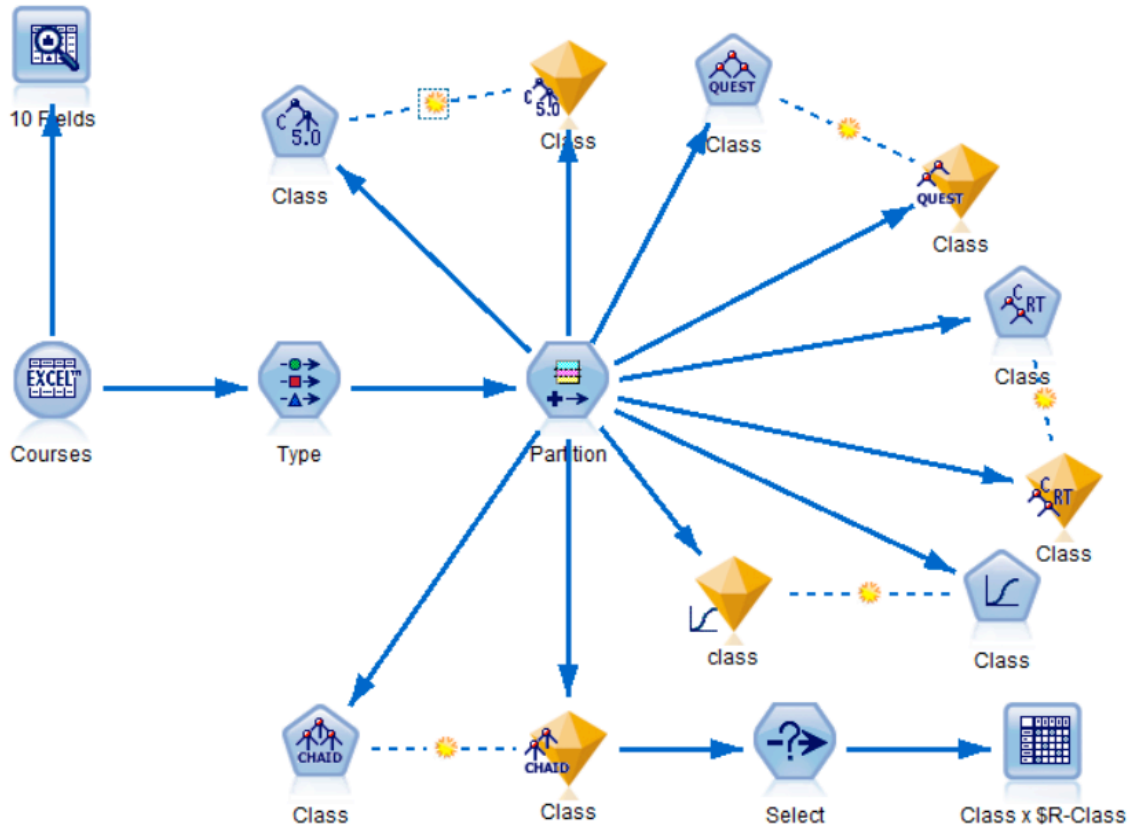
Table 2. Descriptive statistics of the course variables (n=2527)

Variable Name	Possible Values	Count	Percentage
Class	Average	1462	58%
	Better	1065	42%
School	Sch1	479	19%
	Sch2	720	28%
	Sch3	486	19%
	Sch4	842	33%
Semester	1	405	16%
	2	418	17%
	3	404	16%
	4	433	17%
	5	426	17%
	6	441	17%
Discipline	There are 32 unique disciplines	-	-
Level	1	470	19%
	2	896	35%
	3	1031	41%
	4	130	5%
ExamMode	Project	492	19%
	Written	2035	81%
Weightage	Low	1646	65%
	High	881	35%
Qualitative	1	2179	86%
	0	348	14%
Quantitative	1	451	18%
	0	2076	82%
CourseMode	Blended	1105	44%
	F2F	1422	56%

In this learning analytics study, data mining was used to analyse the data to gain a better understanding of the learning environment and outcomes. Learning analytics at its core is the collection and analysis of data associated with learning (Brown, 2011). In recent years, there has been an increase in adoption of learning analytics in educational institutions as it offers a promising approach to better understand learners' learning behaviors to improve their retention and success through appropriate intervention (Tseng and Walsh, 2016).

Data mining techniques such as decision trees (C5.0, CHAID, C&RT and QUEST) and logistic regression were used to evaluate learner's performance and its determinants in blended and face-to-face courses, as shown in Figure 1.

Figure 1. Data Mining Stream



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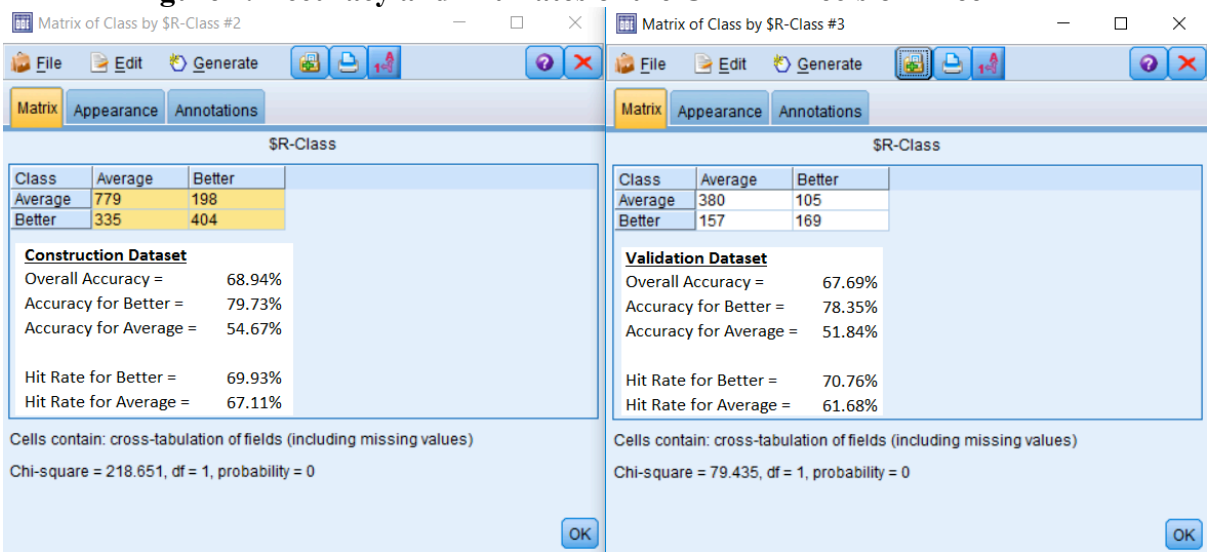
In the study, 70% of the data (i.e., 1716 courses selected randomly) were used to construct the data mining model and 30% (i.e., 811 courses) to validate the model. Both the accuracy and hit rates were used to validate the adequacy of the model.

Findings

From an evaluation of the models, the CHAID decision tree is selected as the final model as it has the highest accuracy rate of 67.7% on the validation dataset. The model results are summarised in Figure 2. A better understanding of the learner's performance and its determinants in blended and face-to-face courses can be obtained by tracing the paths of the decision tree.

Figure 2. Accuracy and Hit Rates of the CHAID Decision Tree



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The decision tree results (as shown in Figure 3) indicate that the blended mode of delivery is associated with better performance for School 1 and 3 courses with a heavy non-written examination component (i.e., Projects). This finding is illustrated in Nodes 9 and 10 and is consistent with prior findings; for example, López-Pérez et al. (2011) and Melton et al. (2009) reported that learners in blended courses obtained better grades. It can be argued learners enrolled in blended courses gain a better understanding of the content as the delivery mode encourages self-directed learning.

Nodes 30 and 31 show that learners in discipline 26 (social services related) performed better in face-to-face courses with written examinations as compared to their counterparts in blended courses with written examinations. This is consistent with Collins' et al. (2002) concern that the use of technology in social services related courses might reduce the importance of meaningful human interaction, suggesting that social services related courses might be best taught via a face-to-face mode.

The decision tree results also show that learners performed better for introductory School 4 (technology) courses with written examination components that were delivered through the blended mode (Node 32) as compared to those delivered via the face-to-face mode (Node 33). For more advanced non-qualitative courses (i.e., level 2 quantitative courses) with written examination components in School 4, learners performed better for courses delivered via a face-to-face mode (Node 39) as compared to courses delivered via a blended mode (Node 38). This may be expected because as the level of difficulty of School 4 courses increases, more practical experience and explanation/interaction (especially for quantitative courses) may be required. With blended courses, face-to-face interaction is reduced and online learning does not provide the same extent of learning.

It is noted in this study that time has no effect on the academic performance of the learners with regard to the mode of course delivery. However, time does have an impact on the academic performance of the learners (Nodes 26 to 29) for discipline 9 (business related), 10 (human development related) and 15 (social services related). It

is also noted that from 2014 to 2016, there was a revamp of the curriculum with the removal of obsolete courses and addition of new courses in these programmes.
Collectively, the findings clearly emphasise that the appropriate course design varies depending not only on the nature and discipline of the course but also the level and coursework component of the course. Universities can consider these determinants when designing their courses to maximise the benefits of both blended and face-to-face courses o learners. The relevant findings are summarised in Table 3.

Table 3. Summarised Findings

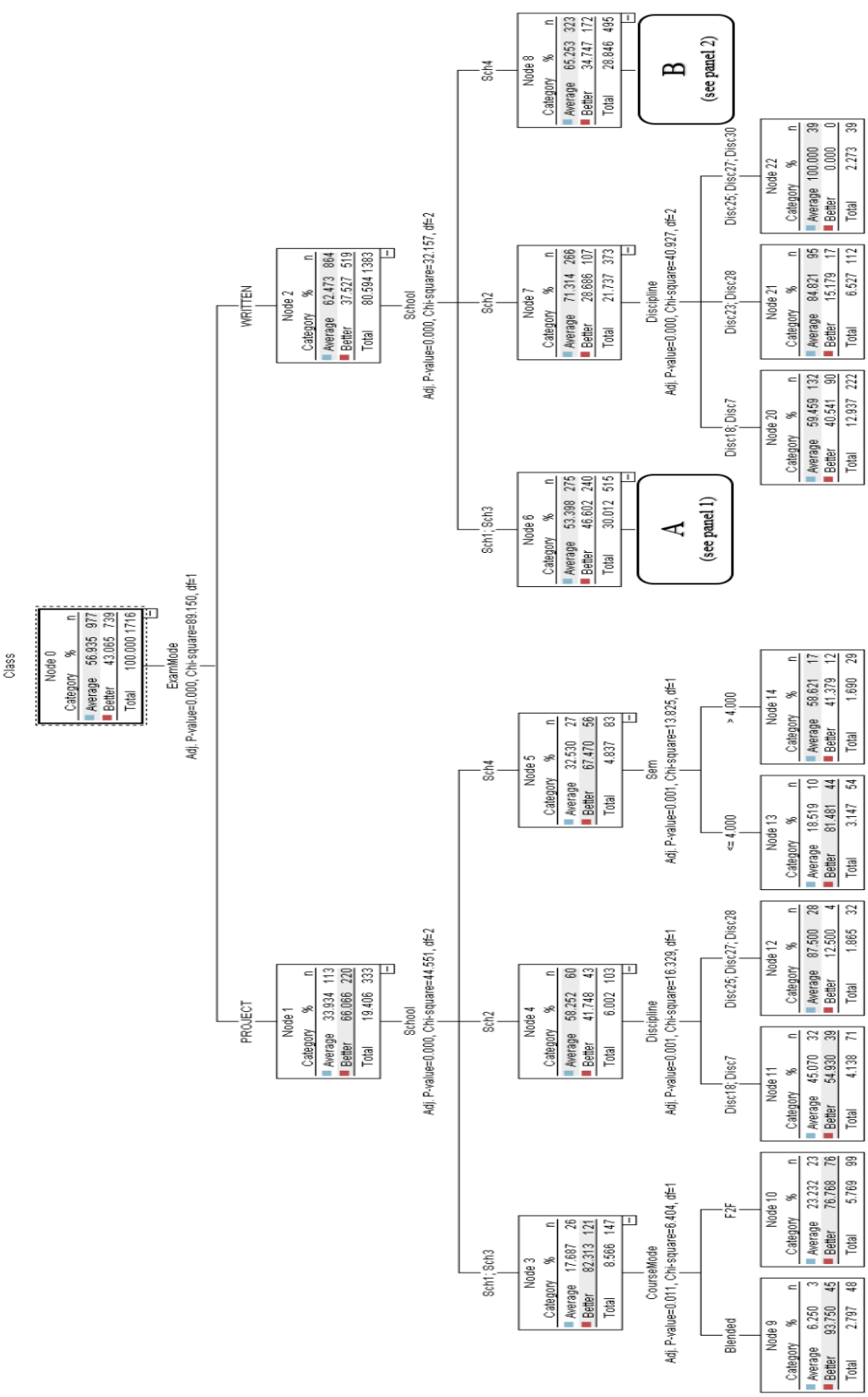
Blended Delivery Mode	**Face-to-Face Delivery Mode**
Appropriate for: 1) introductory courses 2) social services and business courses with heavier coursework components	Appropriate for: 1) advanced quantitative courses 2) written examination social services courses that require human interaction (e.g., social work and counselling)

Conclusion

This study aims to gain a better understanding of the determinants associated with the performance of learners in blended courses vis-à-vis in face-to-face courses across time. Based on the findings and to maximise the benefits of both blended and face-to-face courses, universities can consider designing higher level quantitative courses with more face-to-face delivery and written examination social services courses (such as social work and counselling) that required more meaningful human interaction via face-to-face mode. Furthermore, universities offering social services and business courses with heavier coursework components can consider delivering these courses in a blended mode.

Each course in SUSS is offered only in one specified delivery mode; hence, comparative study of a course offered in different delivery modes is not possible. Further research can study courses that are offered in both the blended and face-to-face delivery modes. Future research can also consider the role of faculty and course assessments as well as learners' attributes (e.g., demographics and prior academic performance) in comparing the learners' learning experience and academic performance associated with different delivery modes.
It is hoped that this study has provided insights into the effects of the mode of course delivery on the academic performance of learners, and the determinants of such effects.

Figure 3. Visualisation of the CHAID Decision Tree



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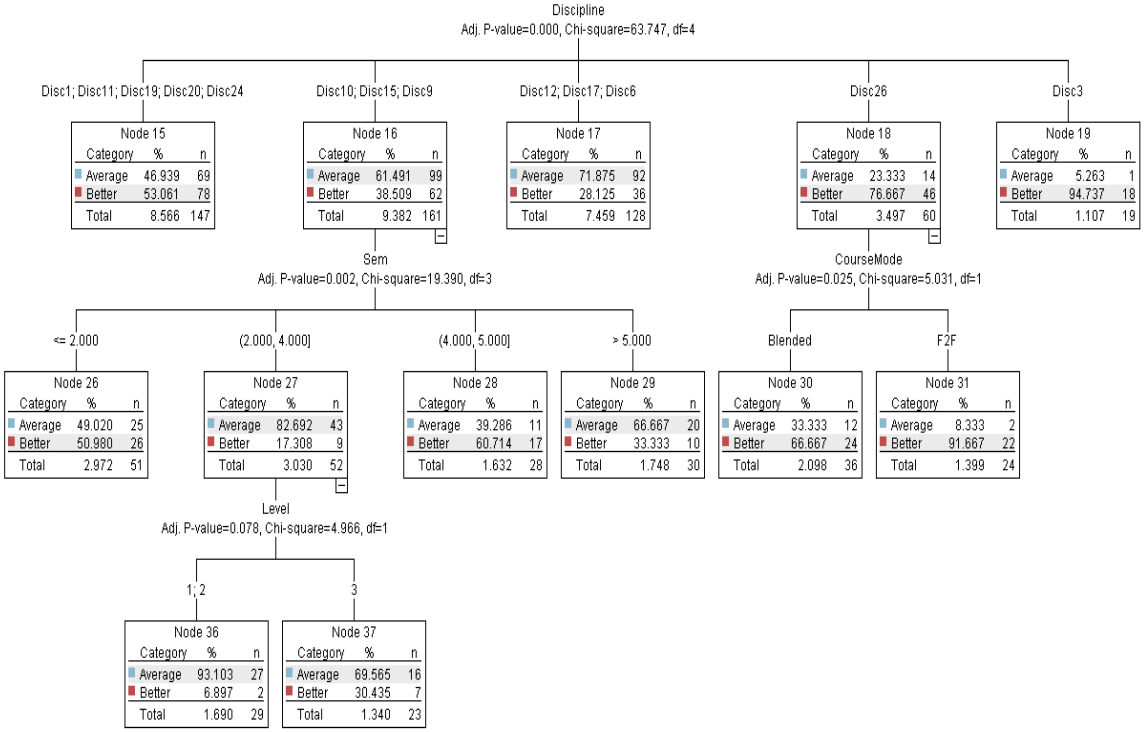
Panel 1 - A



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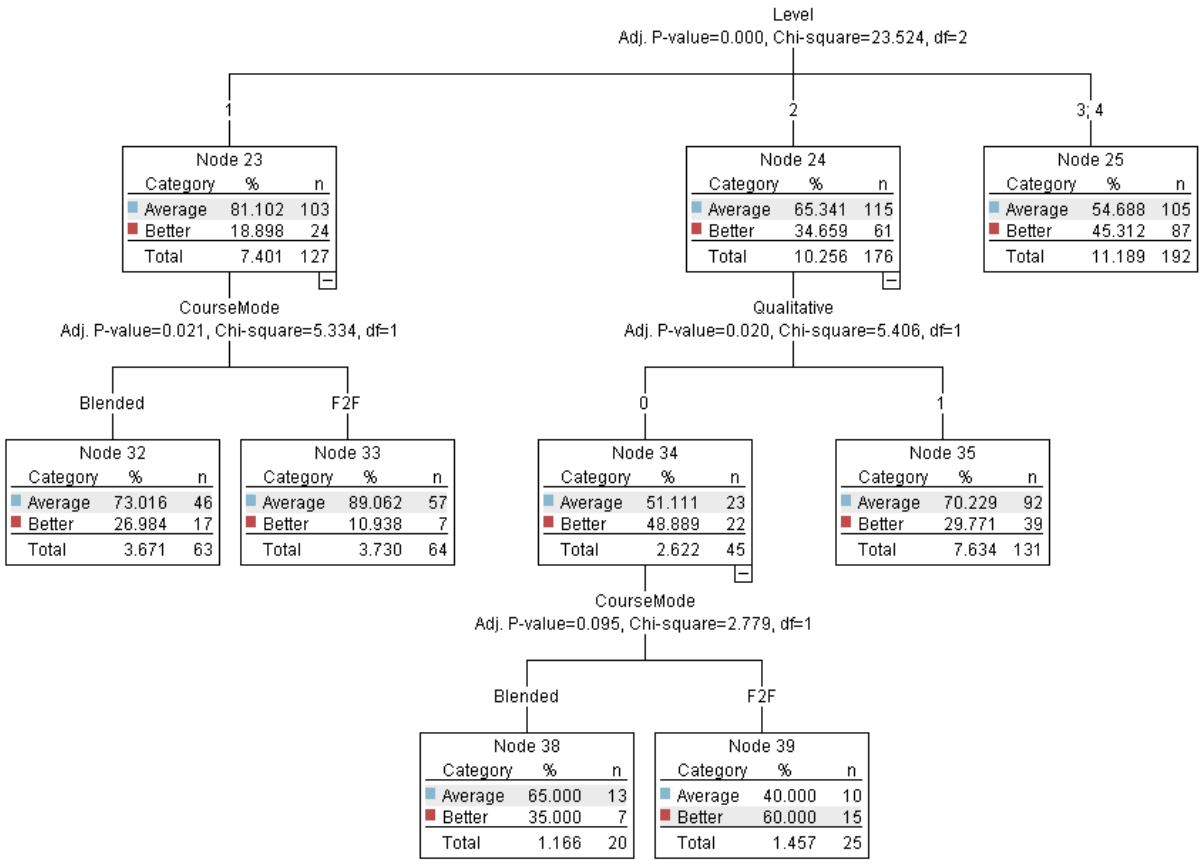
Panel 2 - B



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