Confidence Based Marking: Implementation and Feedback Measures

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Objective type questions (true-false and multiple-choice), while straightforward to grade, have limitations. The answer is scored as either correct or incorrect; partial knowledge of the answer is not measured. Further, the impact of guessing is not observable. An alternative method, Confidence Based Marking (CBM), which addresses both of these issues is introduced. The method is implemented within a course management system (CMS) using true-false questions. Issues related to implementing a CBM within a particular CMS are discussed and addressed. Further, three statistical measures of feedback are introduced. Also, the results of a pilot study using CBM in a CMS are presented. Finally, conclusions are drawn.

INTRODUCTION

Educators at colleges and universities are constantly challenged to find effective and efficient methods of assessing student learning. Assessments utilizing true-false and multiple-choice questions, which are straightforward to grade, are frequently used in courses in higher education. When paired with a Course Management System (CMS) such as Blackboard (Bb), these assessments are amenable to objective grading. Students and instructors can then receive fast feedback and statistics regarding performance.

While useful, assessments employing traditional true-false and multiple-choice questions have several limitations. Confidence Based Marking (CBM), an alternative to objective grading for true-false and multiple-choice questions, aids in addressing the limitations of traditional scoring. The method is explained and a discussion of operationalizing CBM in a CMS is presented. Further, implementation issues related to CBM in a CMS are analyzed. Also, three measures of feedback that can be generated from the results of CBM are introduced. In addition, the results of a pilot study in which true-false questions utilizing CBM in a CMS environment are provided. Finally, conclusions are drawn.

GRADING ISSUES AND ALTERNATIVE GRADING

The effectiveness of traditional assessment feedback is limited by two grading issues: the feedback is single dimensional and guessing by the student may have an impact. Alternative methods to traditional feedback are available which address these limitations.

Grading Issues

Scoring of traditional true-false and multiple-choice questions provides only single dimensional feedback; the answers are marked either correct or incorrect and no credit for partial knowledge is given. A student with partial knowledge of the subject matter of the question may be able to, say, eliminate two of the four choices of a multiple-choice question. Then, the student has trouble selecting the correct answer from the remaining two choices. If the incorrect choice from the remaining two selections is chosen, the student (with partial knowledge) does not receive any credit for the question.

Another challenge, related to the first, in true-false and multiple-choice assessments is that guessing (or chance) may play some unquantifiable role in assessment of learning (Burton, 2001; 2005). A student with no knowledge of the answer to the question may guess and happen to select the correct answer, thereby receiving full credit for the question.

Alternatives to Traditional Scoring

Alternatives to the traditional method of using the number of correct answers as the test score exist. For example, negative marking is an approach that purports to compensate for guessing (Alnabhan, 2002; Bush, 2001). Under the negative marking method, the student receives 1 point for a correct answer and -1 point for an incorrect answer. Such grading effectively discourages guessing, reducing the likelihood students will guess when they have no knowledge. This method addresses the guessing issue, but not the partial knowledge issue.

Besides negative marking, CBM[1], originally proposed by Dressel and Schmid (1953), is another alternative to traditional grading of correct and incorrect for true-false and multiple-choice questions. Under CBM, students are asked to provide their choice of the correct answer for each true-false or multiple-choice question, as well as their level of confidence in each answer. If students express high confidence in the answer and the selected answer is correct, they are rewarded handsomely. They are also penalized significantly for expressing high confidence in an answer which proves to be incorrect (Davies, 2002; Gardner-Medwin, 1995). For lower levels of confidence in answers, CBM reduces both the rewards for correct answers and the penalties for incorrect answers. This method addresses both the partial knowledge and the guessing issues.

IMPLEMENTATION OF CBM IN A CMS ENVIRONMENT

To explore CBM in a CMS environment, the method was implemented utilizing true-false questions in an undergraduate business course.

CBM Scoring for True-False Questions

To operationalize CBM for true-false questions in a CMS, three levels of confidence were utilized. The use of three levels of confidence allows for variation of the answers based on the certainty of the student and is not unwieldy.

The three levels of certainty are: “slightly certain,” “fairly certain,” and “certain.” For each true-false question, the student determined whether the stem was true or false. Then, one of the three levels of confidence in the answer was chosen. Alternatively, the student with no confidence in the answer (no knowledge) could select could select the choice “no contest.” Thus, students were faced with seven choices (true, with three confidence levels; false, with three confidence levels; and no contest). In receiving points for answers, the reward for a correct answer increases with an increase in confidence level. Conversely, for an incorrect answer, the penalty rises with the confidence level.

Students earn 3.0 points, full credit, for the question by giving both the correct answer and expressing complete confidence in the answer. If a student designates being certain of the answer, but the answer is not correct, the result is -1 point. Indicating being fairly certain yields 2.25 points if correct and -0.25 points if incorrect. Students who designate slight certainty of the answer and the answer proves to be correct, receive 1.5 points. However, for students who are slightly certain of the answer but the answer is incorrect, 0.5 points is awarded.

Note that students choosing the no contest option receive 1.0 point. This structure was designed to provide a reward for students comprehending that they did not have knowledge of the correct answer. Also, note that the payoff for being slightly certain and incorrect is positive (0.5 points); while this is a positive number, 0.5 is less than the 1.0 point that the students could have received had they realized they did not have knowledge of the correct answer.

The points assigned for the correct-incorrect answer and the various confidence options (that is, the three confidence levels and the no contest choice) for a question in which the correct answer is true are illustrated in the Figure.

FIGURE 1
A REPRESENTATIVE TRUE-FALSE WITH CBM QUESTION FOR WHICH THE CORRECT ANSWER IS TRUE

Question: Inventions, standards, and products are examples of information systems.

A. I am **CERTAIN** that this statement is **TRUE**. If I am CORRECT, I will receive **3 points**; if I am INCORRECT, I will receive **-1 point**.

B. I am **FAIRLY CERTAIN** that this statement is **TRUE**. If I am CORRECT, I will receive **2.25 points**; if I am INCORRECT, I will receive **-0.25 points**.

C. I am **SLIGHTLY CERTAIN** that this statement is **TRUE**. If I am CORRECT, I will receive **1.5 points**; if I am INCORRECT, I will receive **0.5 points**.

D. **NO CONTEST**. I will get **1 point** for this question.

E. I am **SLIGHTLY CERTAIN** that this statement is **FALSE.** If I am CORRECT, I will receive **1.5 points**; if I am INCORRECT, I will receive **0.5 points**.

F. I am **FAIRLY CERTAIN** that this statement is **FALSE**. If I am CORRECT, I will receive **2.25 points**; if I am INCORRECT, I will receive **-0.25 points**.

G. I am **CERTAIN** that this statement is **FALSE**. If I am CORRECT, I will receive **3 points**; if I am INCORRECT, I will receive **-1 point**.

In the first three choices, the student believes the stem is true, while for the last three choices, the student thinks the answer is false. Choice D is selected by students who believe they have no knowledge of the correct answer (true or false) and realize this fact. Table 1 summarizes the points assigned for a CBM question for the various combinations of correct/incorrect and confidence level[2].

TABLE 1
CONFIDENCE, RISK, AND REWARD

	Confidence			
Points earned when answer is:	Certain	Fairly Certain	Slightly Certain	No Contest
Correct	3	2.25	1.5	
Incorrect	-1	-0.25	0.5	
No Contest				1

General Description of CMS Implementation

A pilot study of CBM implemented via Blackboard 9 (Bb), a commonly used CMS, was administered at a large, regional, public university. A total of 51 students in a junior-level Computer Information Systems course took the exam. Both the correct answer (true or false) and the confidence options (the three levels of confidence and the no contest choice) were utilized in scoring the questions. The assessment contained 50 questions.

In order to compare the results of CBM with traditional scoring, three variations of each question were developed. The three formats used to create the variations were: a traditional true-false format; a true-false with CBM format; and a multiple-choice format.

Each individual true-false question for each student was randomly assigned one of the three formats. That is, each question tested a specific issue, but students may have received the question in the form of traditional true-false, true-false with CBM, or multiple choice. On average, 17 of the 50 questions for each student were traditional true-false questions and 17 were true-false with CBM. The remaining questions, on average 16 per student, were multiple choice[3].

As illustrated in Table 2, the expected value of pure guessing, regardless of the confidence level expressed, is designed to be the same as the points obtained by admitting ignorance through the no contest option. Students are anticipated to choose a certain 1 point for the no contest option rather than risk potential penalties associated with guessing. Thus, the student with low or no confidence in the answer is likely to opt for no contest and the feedback is less likely to be tainted by guessing.

TABLE 2
ILLUSTRATION OF SCORING FOR GUESSING UNDER VARIOUS CONFIDENCE OPTIONS

Scenario: Student answers on four questions.
Two answers are correct and two are incorrect.
Points awarded under varying levels of certainty are in **bold** and underlined.

	Certain		Fairly Certain		Slightly Certain		No Contest
	C	**I**	**C**	**I**	**C**	**I**	
Answered Correctly	**3**		**2.25**		**1.5**		**1**
Answered Correctly	**3**		**2.25**		**1.5**		**1**
Answered Incorrectly		**-1**		**-0.25**		**0.5**	**1**
Answered Incorrectly		**-1**		**-0.25**		**0.5**	**1**
Overall Points Earned	4*		4		4		4

C = Correct answer marked by student I = Incorrect answer marked by student *4 = 3 + 3 + (-1) + (-1)
Note: See Table 1 for point allocations for each combination of correct/incorrect and confidence level.

Challenges to CBM Implementation in Bb

There are two challenges to the implementation of CMB in Bb. The first is that per the points as given in Figure 1, negative points can be assigned in CMB questions; however, Bb does not accommodate negative points.

The second matter relates to the fact that, while three of the seven answers in Bb contain the correct answer (for example, if the correct answer is true, choices A, B, and C all contain the true option), the Bb system only permits one answer out of the seven to be marked correct.

Both the no negative points and the single correct answer issues can be addressed in Bb, through the use of the system's partial credit feature for choices which are not the one selection designated as correct in Bb. The system assigns partial credit as a percent of the (one) answer that is noted as the correct choice in Bb. Thus, an algorithm to assign (nonnegative) points in Bb for answers and then convert those scores to a number in the -1 to 3 point CBM range is necessary.

To illustrate Bb implementation that addresses these challenges, suppose that the correct answer for a question is true. As shown in Figure 1, if A (true, certain) in a CBM question is marked, 3 points should be assigned. Similarly, if the student marks choice G (false, certain), the score is -1. However, recall that Bb does not allow negative points. To address this issue, 1 point is added to all CBM scores in Bb. Thus, for Bb purposes, when the answer is true, the selection of choice A yields 4 points while choice G results in 0 points. Note that the range in Bb, 0 to 4, or four points, is the same as the range, -1 to 3, for CBM noted in Figure 1. Later, the final score from Bb for the student is reduced by 1 point per question; this adjustment yields the CBM final score.

For the second implementation issue, that only one answer in the Bb system may be designated as correct, recall that three answers may be correct (for example choices A, B, and C if the correct answer to a true-false with CBM question is true), a method to appropriately score including any correct (and incorrect and no contest) answers is also needed. The partial credit feature of Bb can be used to address this issue.

Table 3 shows the actual points for each choice and also presents the adjusted points for Bb implementation. As discussed above, if the correct answer is true, choice A (certain, true) in Bb is scored as 4 points and choice G (certain, false) is awarded 0 points. When the student marks a selection of either A or G, which both correspond to a confidence level of certain, there is no need for a partial credit adjustment.

When the student expressed confidence levels of either fairly certain or slightly certain, the partial credit feature of Bb is utilized. For example, choice B corresponds to true and fairly certain and is assigned 3.25 points in Bb (2.25 plus 1). Recall however that only one answer, in this example, choice A, may be designated by Bb as being correct. Thus, to arrive at 3.25 points for choice B, partial credit (ie, partial correct credit) is awarded.

Partial credit is implemented by utilizing a percent of the total. In this case, the percent is 81.25 (100 x 3.25/4). Thus, in Bb, if a student selects choice B when the correct answer is true (and choice A is the one answer designated as correct in Bb), then, Bb, using the partial credit feature, scores the question as the product of 0.8125 and 4 points, or 3.25 points.

Choice C corresponds to true and slightly certain and is allocated 2.5 points (1.5 plus 1). The partial credit percent of full credit is 62.5 (100 x 2.5/4) and is utilized in Bb to score answers which are true and for which the student was slightly certain.

Three choices correspond to the case in which the student believes that the correct answer is false. In E, the student marks false and slightly certain; 1.5 points (0.5 plus 1) is assigned and the partial credit percentage for Bb is 37.5 (100 x 1.5/4). Choice F corresponds to false and fairly certain and is assigned 0.75 points (-0.25 plus 1) in CBM; the partial credit percent for Blackboard is 18.75 (100 x 0.75/4). Finally, G corresponds to false and certain and is assigned 0 points (-1 plus 1) and the partial credit percent for Bb is 0.

The middle choice, choice D, corresponds to the no contest option and is assigned 2 points (1 plus 1) and the partial credit percent for Blackboard is 50 (100 x 2/4).

Once the test has been graded by Bb, the total exam score for each student is adjusted to reflect the fact that 1 point was added to each question regardless of the answer. This is accomplished by multiplying 1 point times the number of true-false with CBM questions on the student's exam and subtracting that number from the individual's total score.

TABLE 3
ACTUAL AND ASSIGNED POINTS USING PARTIAL CREDIT IN BB

CBM Points earned when answer is:	Certain	Fairly Certain	Slightly Certain	No Contest
Correct	3	2.25	1.5	1
Incorrect	-1	-0.25	0.5	1
Bb points assigned when answer is:	Certain	Fairly Certain	Slightly Certain	No Contest
Correct	4	3.25	2.5	2
Incorrect	0	0.75	1.5	2
Partial credit adjustment	Certain	Fairly Certain	Slightly Certain	No Contest
Correct	No adjustment needed	81.25%	62.5%	50%
Incorrect	No adjustment needed	18.75%	37.5%	50%

Note: Assume the correct answer is true.

FEEDBACK MEASURES

Three Feedback Measures

Three feedback measures, reflecting different aspects of student knowledge, can be derived from the use of CBM questions. These measures are termed the *coefficient of infusion,* the *coefficient of confusion,* and the *coefficient of delusion*. The coefficient of infusion, an overall measure of knowledge, is analogous to the test score in a traditional assessment, but takes into account the level of confidence. The coefficient of confusion is a measure of uncertainty students have in their answers. The coefficient of delusion measures student misinformation.

In order to define the three coefficients of feedback, a number of terms must first be defined. These are:

N_T : number of questions in the set
N_c : number of questions that were answered as certain
N_f : number of questions that were answered as fairly certain
N_s : number of questions that were answered as slightly certain
N_n : number of questions that were answered as no contest
Note that by construction, $N_T = N_c + N_f + N_s + N_n$.

For questions that are answered as certain, N_{ck} denotes the number of questions that are marked as correct. Further, N_{cx} denotes the number of questions that are marked as incorrect. The quantities N_{fk}, N_{fx},

N_{sk}, and N_{sx} are defined analogously for questions that are answered, respectively, as fairly certain and slightly certain.

Coefficient of Infusion

The coefficient of infusion, denoted by ρ, is the scaled score from the test. For any given set of student-questions, ρ is the score index that is calculated using:

$$(1) \quad \rho = \frac{3\,N_{ck} + 2.25\,N_{fk} + 1.5\,N_{sk} - N_{cx} - 0.25\,N_{fx} + 0.5\,N_{sx} + N_n}{3\,N_T}.$$

If all questions were answered as certain and all questions were marked as correct, then ρ takes on the value of 1. The coefficient of infusion, ρ would always be less than one and could take on negative values if there are too many questions that were answered incorrectly and the student chose the confidence level of certain. The lower limit is by definition -0.333; this number is the result if all questions were answered incorrectly and the student was certain. This score is standardized such that it takes on a value from 0 to 1 (see Appendix A for conversions of the raw scores for this study).

Coefficient of Confusion

The coefficient of confusion, denoted by σ, is an index of uncertainty and is calculated as:

$$(2) \quad \sigma = \frac{2.25\,N_n + 1.5\,N_s + N_f}{2.25\,N_T}.$$

The value of σ lies between zero and one. If all questions are answered as no contest, σ takes on a value of 1. Alternatively, if all of the questions are answered as certain, then σ takes on a value of 0. A higher σ score indicates the student's greater uncertainty in the answers; a lower σ score indicates less uncertainty.

The weights of questions are chosen to be inversely proportional to the value of the correct answer in the scoring algorithm. For example, if students answer a question as no contest instead of fairly certain, then they are giving up 2.25 points that is risky in order to earn 1 point for sure. Similarly, if students answer a question as slightly certain, instead of fairly certain, they are giving up 2.25 points in order to get 1.5 points that is less risky.

Coefficient of Delusion

The coefficient of delusion, denoted by δ, is an index of misinformation and is calculated using:

$$(3) \quad \delta = \frac{4\,N_{cx} + 2.5\,N_{fx} + N_{sx}}{4\,(N_c + N_f + N_s)}.$$

The value of δ lies between 0 and 1. This coefficient takes on a nonzero value only when a student expresses some level of confidence in an answer, and that answer is incorrect. For example, if all questions that were not answered as no contest were answered as certain, and scored as incorrect, then δ equals 1. If all questions that were not answered as no contest are answered as certain, then δ, by definition, is equal to the proportion of incorrect answers to the total number of questions. As the level of the confidence expressed in an incorrect answer increases, the coefficient of delusion increases.

Questions which are answered as no contest do not affect this measure. Presumably, students indicating no contest have no knowledge of the subject matter of the question and are aware of the lack of knowledge. Therefore, there is no delusion. Again, if all questions are scored as correct, regardless of confidence level, then δ takes on a value of 0. This is another case of no delusion. The student may have some confusion (uncertainty), but the student is not delusional about the (lack of) knowledge possessed.

Coefficients of Confusion and Delusion--Different

The difference between the latter two coefficients is that the coefficient of confusion measures how unsure a student is of the answers while the coefficient of delusion captures the extent to which a student is unaware of the (lack of) knowledge possessed. The coefficients of confusion and delusion capture the degree to which the student is uncertain of the answers and the degree of overconfidence in the answers that the student chose, respectively.

RESULTS

The CBM exam was administered in Bb in a computer information systems course in the business school at a large public university. The results were analyzed by examining the percent of correct answers for both CBM and traditional true-false questions as well as the percent of correct answers by confidence level. Further, the three feedback coefficients were calculated. Finally, a test to ascertain if the feedback coefficients provide distinct pieces of information was performed.

Any Answer Marked, Except No Contest

The proportion of correct answers for each student, regardless of the expressed confidence level, for the true-false with CBM questions that are not answered as no contest is first calculated. For comparison purposes, the proportion of correct answers for the traditional true-false questions is also calculated for each student. The results are given in Table 4.

TABLE 4
STUDENT PERFORMANCE (PERCENT MARKING CORRECT ANSWER) IN TRADITIONAL TRUE-FALSE VS. TRUE-FALSE WITH CBM QUESTIONS

	Traditional True-false	True-false with CBM
Correct answer is true	76.9%	79.6%
Correct answer is false	49.6%	47.0%
Total	63.4%	63.8%

The Table shows that average student performance is almost identical for the traditional true-false and the true-false with CBM questions. Also, the Table illustrates that regardless of whether the true-false test is CBM or traditional, students perform significantly better when the correct answer is true. For both the traditional and the CBM true-false questions, when the correct answer is false, students actually perform slightly worse than they would by random guessing.

Performance by Confidence Level

Next, the proportion of correct answers for each of the three confidence levels, was calculated. The results are given in Table 5.

Table 5 shows that the finding from Table 4 regarding a higher score for questions for which the correct answer is true holds across the three confidence levels. For fairly certain and slightly certain, the performance difference when the correct answer is true relative to when the correct answer is false is over 40 percentage points.

TABLE 5
STUDENT PERFORMANCE (PERCENT MARKING CORRECT ANSWER) IN TRUE-FALSE WITH CBM BY CONFIDENCE LEVEL

	Confidence Level		
	Certain	Fairly Certain	Slightly Certain
Correct answer is true	81.82%	75.68%	75.56%
Correct answer is false	55.79%	34.21%	33.96%
Difference	26.03%	41.47%	41.60%
Total	69.76%	54.67%	53.06%

Feedback Coefficients Calculated

The coefficients of infusion, confusion, and delusion, for each student and for each question were calculated while also distinguishing between the correct answers to the questions. The average values of the three coefficients for all true-false with CBM questions and all students are presented in Table 6.

TABLE 6
FEEDBACK COEFFICIENTS FROM TRUE-FALSE WITH CBM QUESTIONS BY CORRECT ANSWER

	Infusion	Confusion	Delusion
Correct answer is true	59.98%	34.88%	15.93%
Correct answer is false	33.77%	40.07%	38.87%
Difference	26.21%	-5.19%	-22.94%
Total of all questions, regardless of correct answer as true or false	46.99%	37.46%	27.05%

One noteworthy finding in Table 6 is that the coefficient of infusion across all questions (Total row) is approximately 47 percent compared to the average score of 63.4 percent for the traditional true-false test (see total score in traditional true-false from Table 4). Essentially, the traditional format provides over 16 percentage points score advantage to the students. (Recall the coefficient of infusion provides an overall score analogous to a test score, but with rewards and penalties based on confidence level and correctness of answer.)

Another significant finding from Table 6 relates to the coefficient of confusion. The total, 37.46 percent, for this statistic is high and implies considerable uncertainty for students completing the true-false with CBM questions. This high level of uncertainty is observed for both questions for which the correct answer was true (34.88 percent) as well as false (40.07 percent).

Still another observation is that the total coefficient of delusion is approximately 27 percent. While the statistic was about 16 percent for those questions for which the correct answer was true, it was almost 39 percent for questions for which the correct answer was false. In other words, when the correct answer was false, students misestimated their knowledge more so than when the correct answer was true.

Three Distinct Sources of Information

The three feedback coefficients are designed to provide information on the infusion of knowledge by the student, the level of confusion (which the student recognizes), and the amount of delusion the student

has regarding the knowledge (misinformation). To determine if the three feedback coefficients do indeed yield distinct information, simple correlation analysis was conducted. The correlations are calculated using average coefficients for each student. The results are reported in Table 7.

TABLE 7
CORRELATION OF FEEDBACK MEASURES

	Delusion	Infusion
Confusion	-3.10%	-54.10%
Delusion		-69.80%

The results show that the coefficients of confusion and delusion have a small negative correlation. In addition, both the coefficients of confusion and the delusion are negatively associated with the coefficient of infusion. It appears that uncertainty (confusion) and misinformation (delusion) are negatively associated with overall knowledge scores. These findings imply that there are three distinct factors that determine the values of the three feedback measures.

CONCLUDING REMARKS

CBM is an alternative method for scoring traditional true-false and multiple-choice questions in an exam which allows the student to select an answer to the question and also specify the confidence level in the selected answer. The method was operationalized in Bb, a CMS environment, for a business class. Besides the scores in CBM (taking into account the various confidence levels), coefficients of feedback can be calculated using the CBM data. The three coefficient relay information regarding the student's infusion of knowledge, the confusion of the student (which the student recognizes), and the delusion the student has regarding the knowledge/lack of knowledge of the subject matter.

CBM provides valuable feedback not available from traditional grading of objective questions and addresses both the grading issues of partial knowledge and guessing. Instructors can utilize the measures introduced to guide them in designing materials to reinforce difficult concepts. Also, students can employ CBM and the feedback coefficients to help them grasp what concepts and areas of the coursework which they need to focus on.

NOTES

1. Dressel and Schmid used the term "Degree-of-Certainty' testing.
2. Finding the optimal payoff structure to enhance student learning is beyond the scope of this paper.
3. The multiple choice questions are not considered further in this article.

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APPENDIX

Conversion of Coefficient of Infusion to 0 to 1 Scale

Raw Score	Converted Score	Raw Score	Converted Score	Raw Score	Converted Score	Raw Score	Converted Score
-0.333	0.00	0.014	0.26	0.347	0.51	0.680	0.76
-0.320	0.01	0.027	0.27	0.360	0.52	0.693	0.77
-0.306	0.02	0.040	0.28	0.373	0.53	0.707	0.78
-0.293	0.03	0.054	0.29	0.387	0.54	0.720	0.79
-0.280	0.04	0.067	0.30	0.400	0.55	0.733	0.80
-0.266	0.05	0.080	0.31	0.413	0.56	0.747	0.81
-0.253	0.06	0.094	0.32	0.427	0.57	0.760	0.82
-0.240	0.07	0.107	0.33	0.440	0.58	0.773	0.83
-0.226	0.08	0.120	0.34	0.453	0.59	0.787	0.84
-0.213	0.09	0.134	0.35	0.467	0.60	0.800	0.85
-0.200	0.10	0.147	0.36	0.480	0.61	0.813	0.86
-0.186	0.11	0.160	0.37	0.493	0.62	0.827	0.87
-0.173	0.12	0.174	0.38	0.507	0.63	0.840	0.88
-0.160	0.13	0.187	0.39	0.520	0.64	0.853	0.89
-0.146	0.14	0.200	0.40	0.533	0.65	0.867	0.90
-0.133	0.15	0.214	0.41	0.547	0.66	0.880	0.91
-0.120	0.16	0.227	0.42	0.560	0.67	0.893	0.92
-0.106	0.17	0.240	0.43	0.573	0.68	0.907	0.93
-0.093	0.18	0.254	0.44	0.587	0.69	0.920	0.94
-0.080	0.19	0.267	0.45	0.600	0.70	0.933	0.95
-0.066	0.20	0.280	0.46	0.613	0.71	0.947	0.96
-0.053	0.21	0.294	0.47	0.627	0.72	0.960	0.97
-0.040	0.22	0.307	0.48	0.640	0.73	0.973	0.98
-0.026	0.23	0.320	0.49	0.653	0.74	0.987	0.99
-0.013	0.24	0.334	0.50	0.667	0.75	1.000	1.00
0.000	0.25						

The above table indicates the raw score using the formula for coefficient of infusion.

$$(5) \quad \rho = \frac{3\,N_{ck} + 2.25\,N_{fk} + 1.5\,N_{sk} - N_{cx} - 0.25\,N_{fx} + 0.5\,N_{sx} + N_n}{3\,N_T}.$$

The converted scores standardize the raw score to a range of 0 and 1 inclusive. The raw scores range from -.333 to 1.0. The conversion to a 0 to 1 scale takes the range of the raw score (1.333) and uses it in the denominator of the formula as follow:

(6) Converted Score = (ρ + 0.333) / 1.333.