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In This Issue:

MACUB 2015-2016 Executive Board	inside cover
Instruction for Authors	inside cover
Factors Affecting Academic Performance of Students Enrolled in Biology Courses at a Community College By Shazia Khan and Atique Khan	88
The Growth of an Assessment Culture in a Biology Department By Seher Atamturktur, Shazia Khan and Richard LaManna	101
Correction - Member Abstract, Clinical Reasoning Assessment of Case Study Practice in Gross Anatomy by Patrick R. Field	115
Affiliate Members	inside back cover

Save the Date

**The 2016 MACUB Conference will be at
SUNY College at Old Westbury
Oct. 29, 2016**

Factors Affecting Academic Performance of Students Enrolled in Biology Courses at a Community College

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Abstract

This study explored community college biology students' perspectives about various factors affecting their academic performance. Using open-ended questionnaire, students were asked to describe their lifelong socioeconomic experiences that may have had an impact on their emotional well-being and academic goals. Data collected from the interviews with 20 adult community college students was manually transcribed and analyzed using Nvivo software. The findings suggest that socioeconomic environment had significant influence on students' emotional well-being and academic performance. Participants' perspectives revealed that additional learning initiatives for biology students, such as tutoring, study labs, and student support services are needed to improve their ability to deal with the academic pressure; thereby increasing the likelihood of completing their education as intended.

Introduction

This study explored affects of socioeconomic environment on academic performance, and persistence of biology students living in economically disadvantaged neighborhoods in New York City. The Biology Department at Bronx Community College (BCC) campus was chosen for this study because the demographic profile and socio-economic and academic challenges BCC students encounter¹, while pursuing postsecondary education, are consistent with the problems community colleges students face nationwide². The graduation rate of full time 2008 entering students after two years was 0.7 %, and after three years of study 8.3% of students graduated from the BCC campus of the City University of New York (CUNY)³. Another reason the Biology Department was chosen for the study because of its high enrollment^{1,3} as

compared to most other departments, and the principal author's familiarity with the diverse student population at BCC and various academic enhancement programs the college has instituted to help students cope with the rigorous academic programs.

Background

Many students pursuing post-secondary education at community colleges have weak academic performance and lack social and behavioral skills necessary to perform better in schools⁴⁻⁶. Various socioeconomic reasons including financial hardships, appropriate parental guidance, and deteriorated emotional well-being are responsible for a weak academic background of community college students⁷⁻⁹. Emotional and psychological well-being is considered as a predictor of

success in academic and professional environment and the deficiency of stress coping ability among students places them at a greater risk of dropout before completing their education¹⁰⁻¹².

National Center for Educational Statistics' 6 years data¹³ shows that 41% of community college students drop out in the first year of college and do not return. A high student attrition rate in community colleges highlights a concern that many students may leave academic programs before completing their education due to the lack of learning abilities or various other reasons^{14,15}. Organization for Economic Cooperation and Development (OECD)¹⁶ points out the likelihood that only 29 % of American young adults will pursue post secondary education if their parents did not have higher secondary education. This prospect for those seeking higher education in the U.S. is one of the lowest among OECD countries. Among the problems responsible for students' poor academic achievements is socioeconomic status (SES) that not only affects students' quality of life and emotional well-being, but also influences their intellectual development and academic achievements¹⁷. Individuals' experiences while growing up have strong influence on their behavior and interaction with others¹⁸. Children's cultural and social upbringing provides a foundation for new emotional and cognitive learning¹⁹. A considerable relationship exists between socioeconomic status and academic achievements of college students^{5,8,17,20}.

An abundance of research^{2,4,21,22} highlighted the problem that a majority of community college students are unable to maintain satisfactory academic performance and leave school without completing their education. Borglum and Kubala²³ found that community college

students' retention rate does not represent healthy prospects for the United States' educational system, as the nation-wide community college student attrition rate is almost double as compared to four-year colleges²⁴. Many community colleges do not have intervention programs to provide students better academic and emotional counseling; only one third of the students are able to graduate within their expected degree completion time. Some educational institutions have implemented various training programs to help students deal with emotional stress and improve academic and social skills²⁰. Various studies observed that the social skill improvement programs are among the most successful intervention tools to enhance student learning^{20,23,25}. Family support is also necessary to foster intellectual and emotional growth among students²⁶.

Students with high emotional strength are better learners, demonstrate better stress handling and higher critical thinking skills, establish better relationship with others, and are more optimistic about the future¹². Scholars also suggest that community colleges should institute programs that improve students' academic as well as social and life coping skills^{12,25}. A curriculum that relies exclusively on traditional teaching and does not take into account students' emotional and learning difficulties might not produce desirable results²⁵.

Material and Methods

Several sources^{27,28,29,30} were consulted with to prepare the research design of this study. Creswell²⁷ recommended identifying the problem and its significance for society before selecting a methodology and research design. The

researchers employed open-ended interviewing technique to collect data and to ensure that all relevant aspects of participants' life experiences were properly recorded³¹. An interview with each participant continued for about an hour until new themes stopped emerging which indicated that the subjective viewpoints of participants were fully explored. The open-ended questions created a discussion forum for each participant to share his/her views about the factors that affects students' learning and their ability to achieve desired results. The data were collected using telephone interviews of 20 volunteer students selected using a sample of convenience from the biology students at the Bronx Community College, Bronx, New York.

The researchers chose telephone interview as a medium for this research because of two reasons, First, to save participants' time and cost for travelling for this interview, as suggested by other research^{32,33}. In some cases, even the telephone interviews had to be rescheduled many times because of the participants' unavailability. Second, this allowed the participants to provide a narrative account of their lifelong experiences from locations where they felt at home and comfortable³². Various studies have cited many advantages of telephone interviews; such as convenience for volunteer participants³³, freedom to stay in their own environment that helped increase rapport³⁴, increased accessibility to participants living far away^{33,35,36} and creating the feeling of anonymity^{33,36}.

Research Questions

The research questions were designed to identify various factors responsible for students learning barriers

leading to premature departure from school. These questions probed students' perspective about the effectiveness of educational system in helping students achieve the desired goals and the steps educators should take to improve the quality of education and student retention. A qualitative approach also helped explore the influence of socioeconomic environment on emotional intelligence, academic performance, and career success of students.

1. How do students perceive the effects of socioeconomic environment on emotional well-being?
2. How does socioeconomic environment and emotional well-being effect students' academic performance and their ability to persist in school?

Sample Selected for this Study

The sample selected for this study was from the Biology Department, which is one of the biggest at Bronx Community College: the college consists of about eleven thousand students³⁷. Finkelstein³⁸, Williams and Ritze¹ noted that that the majority of student population shares the same socioeconomic and demographic profile. In a progress report submitted to the Middle States Commission on Higher Education, the BCC president reported that More than 85% of the students enrolled at the Bronx Community College had a weak academic background and required remedial coursework¹. City University of New York³⁹ data and the college president's report¹ shows that due to low-income status, more than 90 % of the students were receiving federal and/or state financial aid to continue their education. In addition, a large number of these students had English as their second language that added additional

learning barriers to their already weak academic background.

Despite extensive solicitation, no student with at-risk status, academic probation, or suspension agreed to participate in the study. Because of higher than college average GPA of the participants, this sampling frame reflects unintentional bias towards students who have better academic performance. According to the City University of New York, Office of Institutional Research and Assessment⁴⁰, women comprised nearly 60% of the BCC's student population. Therefore, a 75% female distribution in this sample also reflects an unintentional bias toward female students because these were the only volunteers who agreed to participate in the study. However, the rest of demographic profile of the interviewees (Table 1) is comparable to the general student population.

Interview Protocol

The researchers used a checklist to ensure that the study was conducted using a structured process before, during, and after the interview. In addition, an interview script was used to inform interviewees that their participation was voluntary and they reserved the right to withdraw from the study at any time without penalty or loss of any benefits. The naming convention PnX was used. The first two letters in this naming convention referred to participants 1-20 and third letter indicated their gender.

Interview Questions

Five open-ended foundational questions were used to elicit biology students' experiences regarding the quality of life and emotional well-being

that may have affected their learning abilities and academic performance. These questions provided participants the opportunity to share their views about the effectiveness of various learning improvement programs offered by the community college. The participants were asked to describe their level of optimism in achieving the career goals.

1. Describe the quality of your life as a child?
2. Describe the quality of life now as an adult?
3. Describe your views and experiences about the effects of socioeconomic status on your emotional well-being?
4. Describe the effects of life events on your learning abilities?
5. How optimistic are you about achieving your career goals?

In addition, follow up probing questions such as, how did your life experiences affected you and what thought stood out the most from that experience. These question encouraged participants to stay engaged in the conversation and freely discuss their thoughts and feelings.

Data Analysis

The researchers manually transcribed all the interviews and saved transcript as MS-Word file using the unique ID assigned to each participant. After the transcription was completed, all transcribed interviews were manually verified for accuracy. Maintaining rigor in a qualitative study is very important for the validity and reliability of the study⁴¹. In order to achieve that goal, both researchers performed initial data analysis independent of each other. As the analysis process proceeded,

Table 1. Demographic Profile of the Participating Students

		No of Participants	% of Participants
Gender	Female	15	75
	Male	5	25
Age	18-25	13	65
	25-35	6	30
	35-45	1	5
Ethnicity	African American	12	60
	Hispanic	6	30
	Asian	2	10
Language	English as Primary	5	25
	English as Secondary	15	75
Students' Status	Full Time	14	70
	Part Time	6	30
GPA	3.5 or above	4	20
	3.0-3.4	5	25
	2.5-2.9	9	45
	2.2-2.4	2	10
Financial Aid Students	50% or more	14	70
	Not Receiving any financial aid	6	30
Remedial Coursework	Participants required remedial coursework	13	65
	Participants required no remedial coursework	7	35

statements from other participants with similar thoughts were discovered, and added to *common views* (same idea expressed by different respondents). The existing themes were refined so that the participants' inner experiences could be appropriately labeled and represented. After several reviews of the statements, 28 *common views* were finalized. The participants' *common views* were then

clustered into 5 themes that emerged based upon the interview questions and the relevancy among themes. Final five themes that emerged are presented in the table 2.

This research study was approved by the Bronx Community College IRB.

Table 2

No	Theme	Common Views	No. of Common Views views
1	Quality of Life Growing Up	Environment or the neighborhood was not good	6
		Good neighborhood and friendly people	10
		Good relationship with family and friends	10
		Loving and caring parents	12
		Parents were loving but authoritative and strict	8
		Quality of life was good	9
2	Quality of Life Now	Content with neighborhood and work environment	5
		Not satisfied with the quality of life or the neighborhood	11
		Satisfied with my life	4
3	Effects of Environment and Life Events on	Environment and life events had negative effect	12
		I wish life could be better	8
		Life events made me stronger and work harder	7
		Religion had positive influence	7
4	Effects of Environment and Life Events on	Relationship with family and friends makes me feel better	8
		Education is very important for my career	15
		High school education or environment was not good	8
		High school education was good	12
		Trying to improve my GPA	10
		Lack of focus and career goals have adverse effect on students	12
		To qualify for financial aid, required course workload pr semester to is very stressful	12
		Socioeconomic environment and life events had adverse effects	14
		Socioeconomic environment and Life events had positive effects	6
		My parents cared about my education	14
Pear Tutoring helped improve my learning	14		
5	Motivation and Optimism to Achieve	Confident, motivated, and optimistic to achieve career goals	18
		Graduated or exceeded credits required to graduate	4
		Graduating within normal time frame	15
		Socioeconomic hardships will not discourage me	3

Results and Discussion

Fourteen participants (70%) were satisfied with the quality of life as a child. Loving and caring parents provided participants an emotional foundation that played a positive role in participants' emotional well-being. The participants described good neighborhoods, good friends, and satisfying life growing up. A positive and well-nurtured upbringing, despite current advised circumstances, provided a strong determination to succeed in life⁴². With appropriate family support, that nurtures emotional and intellectual growth, young learners are well positioned for smooth transitions from early school years to higher educational settings²⁶.

Quality of Life Now

Eleven participants (55%) expressed dissatisfaction with the present quality of life due to socioeconomic struggle as compared to life they enjoyed in their childhood. Long working hours to meet the family needs are not conducive to learning and scholastic activities. Various setbacks made learning and education harder and career aspirations very difficult to achieve. Reynoso⁴³ asserted that low socioeconomic status is an obstacle that undermines academic performance of ethnic minority student. The participants with no socioeconomic hardships indicated satisfaction with the quality of life and that reflected in their higher grades achievement.

Effects of Environment and Life Events on Emotional Well-being

Twelve participants (60%) indicated some negative effects of environment and life events on their general emotional well-

being. They stated that life could have been better and happier had they not encountered negative events in life. It was essential for the participants to have a quiet and peaceful environment to focus on their studies and achieve an optimum academic performance. Prior studies have noted that emotional disorder is a leading cause of poor academic performance among young students²². Life events such as family breakdown, abuse, and financial hardships could have devastating effects on the emotional well-being of young people⁴⁴. Roman, Cuestas, and Fenollar's⁴⁵ findings also supports the finding of this study that most participants felt emotional support from the family improved their self-esteem, quality of life, and stimulated intellectual growth.

Effects of Environment and Life Events on Students' Academic Performance

Fourteen participants (70%) expressed views that the time and efforts required to fulfill family needs and to earn a living created stress and anxiety that was emotionally difficult for the participants. Adverse socioeconomic environment such as family responsibilities, long working hours, and strained financial resources exert pressure that reduce community college students' resiliency and may force them to abandon their quest for education and leave college permanently⁴⁶. These unfavorable socioeconomic conditions have a substantial role in student's attrition. Tovar and Simon⁴⁶ argued that efforts that extend beyond simple financial aid are needed such as "providing support services such as counseling, academic advising, financial aid guidance, and tutoring are all necessary" (p, 548).

Motivation and Optimism to Achieve Education and Career Goals

Despite the fact that the majority of participants faced socioeconomic hardships, all expressed a strong determination to achieve education and career goals. The thoughts of a better life ahead provided a higher level of motivation for the participants that made them work harder to achieve their academic and career goals. Peer influence, parental role, and educational environment play a substantial role in student's academic achievement⁴⁷. Students spend significant time in school on learning and socialization activities. A quality time spent on extracurricular and interscholastic activities improved motivation that resulted in higher academic achievements⁴⁸. Support from parents, teachers, and peers instills motivation; whereas, lack of support or hostile environment could demoralize students and leave them feeling helpless. Higher motivation helped students control anxiety; that the positive state of mind resulted in improved grades⁴⁹.

Validity and Reliability

Quantitative and qualitative methodologies have their own strengths and weaknesses and both may have some validity and reliability problems⁵⁰. Quantitative methods are generally reliable but are not always valid, whereas, qualitative methods are generally valid but not always reliable. A personal judgment, subjective evaluation, and concerns for quality play an important role in all phases of qualitative research⁵¹. Westmarland⁵² posited that the data in quantitative and qualitative research is handled and interpreted by humans conducting research; therefore, a bias in terms of

researchers' subjective approach is always present in both quantitative and qualitative research methodologies. Maintaining rigor in qualitative research is critical to the validity and reliability that was achieved in this research by employing a structured design, data collection protocol, and data interpretation methodology as recommended by several studies^{29,53,54}.

Seeking guidance from prior similar studies to frame a research design will ensure the internal validity and quality of research^{55,56}. In this research, a clearly defined process was used to enhance the rigor and validity of this study. First, the interviews were transcribed ensuring that the participants' views accurately reflected in the transcribed text. Second, the transcripts were manually verified and peer reviewed for accuracy and to eliminate errors that may have occurred during transcription. Third, the guidance from other scholarly sources helped preserve the accuracy and validity of this study. These steps were essential to ensuring the truthfulness of the results and that the research accurately reflected what was actually intended^{53,54,29}.

Conclusion

Pursuing post-secondary education at community colleges is much more stressful than high school curriculum that does not prepare them well for college^{57,58}. Integrating social and emotional learning (SEL) programs with academic courses could enhance student engagement in the educational process⁵⁹. Without any emotional support, students feel isolated and lose confidence in their learning abilities. As the results indicate that participants' support the theme that enhance motivation and sense of connectedness with education should be

incorporated into the curriculum to increase students' desire to perform better in class and achieve career goals⁴⁸. Improved academic performance will instill a sense of purpose among the students and will encourage them to stay in school to complete their intended educational goals. Literature indicated that peer tutoring and online learning support programs are economical for the institution to implement and provide wider access to the student community^{60,61,62,63}.

The importance of these supportive learning tools becomes more evident as the BCC Office of Institutional Research⁶⁴ data showed that nearly 90% of freshman students require some remedial coursework. Most participants of this study stated that online programs that compensate classroom instructions are valuable tools to enhance students' learning. By acclimating students with online instructional material, teachers can better prepare students for online education⁶². It is important that educators and policy makers find ways to improve high schools' educational environment and the quality of education. Valuable financial resources are wasted in college on remedial courses to enhance students' math, science, and English skills that they should have developed in high school⁵⁸.

Further studies are needed on this subject using longitudinal qualitative approach to explore 4 to 6 years of students' experiences while pursuing post secondary education in biology at community colleges. This will allow researchers to evaluate changes in students' life experiences during the course of their education. In this study, despite repeated probing, many participants who were senior students could not recall some of their experiences they encountered at the beginning of their post-secondary education. Longitudinal

study approach will allow researchers to assess the changes in students' psychological condition and its effects on their academic performance⁶⁵.

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The Growth of an Assessment Culture in a Biology Department

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Abstract

This paper describes the development and implementation of a course assessment method that allows faculty to utilize common questions, collect meaningful data and implement the findings to improve student learning. This assessment method is governed by four principles: that it be automatic, systemic, sustainable and meaningful. Over the years of honing the process, we have naturally expanded our department's teaching philosophy to include outcomes assessment and no longer regard it as a mandatory task imposed on faculty. Because the department chair and faculty have come to share the belief and experience that successful student learning requires continual assessment, we have been successful in sustaining rigorous assessment. Consequently, assessment results of the Biology courses are continuously examined and discussed in the department and individual course meetings. The Biology department has made a significant effort to ensure that the learning process, from choosing assessment questions to discussing results, is a collective activity for all faculty involved and that their feedback is valued in making adjustments and providing remedies. Overall, we believe that the Biology department has established an "assessment habit." Our efforts continue to refine our current course level assessment and expand it to program level assessment.

Introduction

The attitudes and the behaviors of individuals, programs and departments within institutions determine whether an assessment culture can exist and how well it functions¹. When an assessment culture thrives within a department, course and program improvements are inevitable and improvements in the program or next iteration of courses provide the impetus for continual improvement. "Closing the Loop" becomes a natural process to the faculty, who come to see assessment as inquiry into classroom effectiveness. Accountability to regional accrediting organizations is critically important, but

once a cycle of improvement becomes embedded in the pedagogical domain, the assessment cycle takes on a momentum of its own, and the beneficiaries are students and faculty.

Fifteen standards contributing to the attitudes and behaviors of a true culture of assessment have been identified, most of which can already be found in a functioning institution: (1) clear general education goals; (2) common use of assessment-related terms; (3) faculty ownership of assessment; (4) ongoing professional development; (5) administrative encouragement of assessment; (6) practical assessment plans; (7) systematic assessment, or an assessment cycle; (8) student learning

outcomes for all courses and programs: (9) comprehensive program review; (10) assessment of co-curricular activities; (11) assessment of overall institutional effectiveness; (12) informational forums/workshops about assessment; (13) inclusion of assessment in plans and budgets; (14) celebration of successes; and (15) responsiveness to proposals for new endeavors related to assessment. Only when an institution, its programs and departments are on the path to meeting these standards can its claim to a culture of assessment be taken seriously^{1,2}. In order to meet the two criteria, improvement and accountability, governing the fifteen principles, and adopt as many of the elements as possible on the departmental and program level, the Biology faculty has, through practice, streamlined the assessment process into their teaching.

Materials and Methods

The Biology Department began its transformation by assessing first Anatomy and Physiology I and II (BIO 23 and BIO 24) in 2007; later, General Biology I and II (BIO 11 and BIO 12), Microbiology and Infection Control (BIO 28), Medical Terminology (BIO 22), and Human Biology (BIO 21). Later, Medical Laboratory Technology (MLT) courses were added to the growing list of regularly assessed courses.

In most of these courses student performance is measured by four in-class examinations, each given at the completion of prescribed topics. In addition, a final examination is given at the end of the semester. The format of the final exams includes in large part multiple choice questions that assess general knowledge, analysis, and application of the concepts covered. Though presented

as “multiple choice,” to answer these questions correctly requires critical thinking on the part of the student. The final examination is cumulative and contains a set of questions (about 25-33%) common to all sections of the course, with emphasis on basic concepts. Similarly in the lab components of the courses, direct assessment is done by weekly quizzes and two practical examinations, a midterm and final exam, involving the use of models and microscope slides. A less direct assessment entails completion of laboratory worksheets for each topic covered. The worksheets are designed to emphasize essential knowledge, guide students through textbook reading, promote conceptual understanding, and advance application of the key elements in relevant topics. While this assessment method is somewhat dependent on instructional style, the assessment may entail either verbal responses during in-class discussions or written responses to selected or all components of the worksheets.

Developing an Assessment Culture

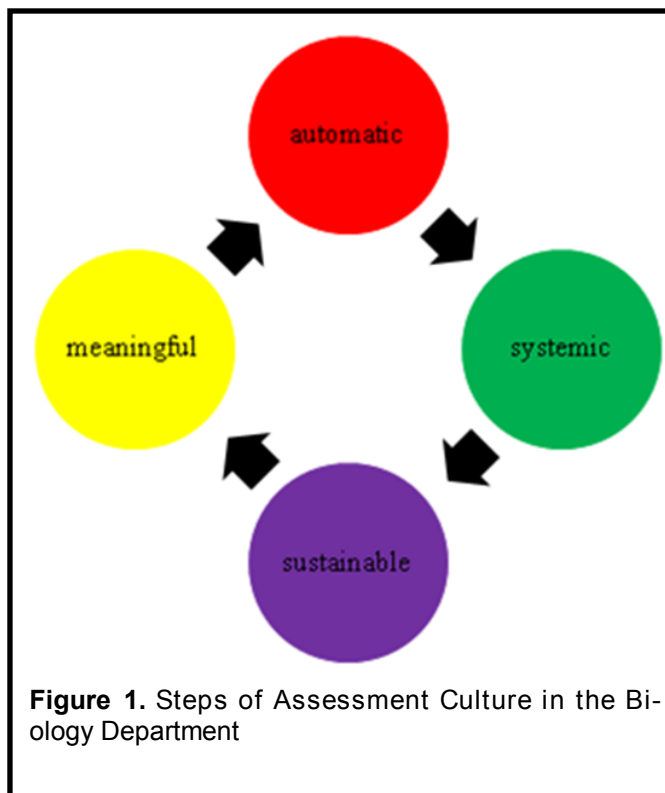
The adoption and implementation of an assessment plan is best begun promptly when the need is recognized and the plan is encouraged to evolve. It is important to adjust the need for shareholder buy-in within the time required for sound implementation. The assessment efforts in the Biology Department progressed concurrently with Bronx Community College’s growing assessment expertise and experience. Beginning in 2001-2002, a comprehensive approach to instituting effective academic assessment of student learning across the curriculum was initiated, which included the creation of a

campus-wide academic assessment committee and a focus on raising academic assessment consciousness and capability across the campus. At that point the college assessment committee came up with an assessment project development template, then improved into a new template called 8-Point Planning & Reporting Assessment form which included identifying student learning outcomes to be assessed, skills, knowledge, values or attitudes expected of students, and what program/course teaching goals these outcomes fulfill. The 8-Point form also asked faculty to identify in what courses these outcomes would be addressed, identify any of these outcomes that speak to the College's General Education goals and proficiencies, and explain their relationship³. Several probes were developed to view the rationale for assessing these Gen-Ed proficiencies and to identify problems or issues regarding student learning. The aforementioned 8-Point form also called for faculty to identify trends such as which curriculum components, including recently implemented new or revised courses, appear to be most challenging to students.

Design of an Assessment Culture

A culture of assessment is defined as "an organizational environment in which decisions are based on facts, research, and analysis, and where services are planned and delivered in ways that maximize positive outcomes and impacts for customers and stakeholders⁴." Keeping that in mind the assessment culture we created in the Biology Department follows a step-by-step process which is characterized by four guiding principles: **automatic, systemic,**

sustainable and meaningful. This model is rooted in the assessment framework developed by respected experts in higher education⁵. Let us describe the development and the implementation of a course assessment method that allows faculty to use the common questions, collect meaningful data, and discuss the findings for improvement of the process across all the courses in the Biology Department⁴ (Fig. 1).



First Principle: Automatic

The Biology Department's first guiding principle for academic assessment is that assessment process should be **automatic**. This part of assessment practice can be broken down to four simple steps.

1. Establish student learning outcomes and general education goals for the course.
2. Generate assessment plans and vehicles.
3. Measure and analyze whether these goals have been met.
4. Schedule informational forums to make changes if necessary to improve teaching and learning in the course assessed.

The Biology faculty first established the measurable student learning outcomes using Bloom's Taxonomy⁶ in courses undergoing assessment to improve teaching and learning and for accountability purposes⁷. Later, they were published in the study guides for all Biology courses. While this process was underway, the College was defining the General Education proficiencies that would be incorporated across the curricula. Each curriculum was required to address some, if not all, of these proficiencies (Table 1).

In order to comply with BCC's mission, Biology faculty and course coordinators worked together to align the student learning outcomes with Bronx Community College's General Education proficiencies. Student learning outcomes, when aligned with the proficiencies, address the academic, technological, and professional skills of general education. In the academic area, these outcomes ensure that students acquire the ability to manage both qualitative and quantitative information. The prerequisite for this process is effective communication with the instructors and peers. Technologically, students are expected to engage in information searches and deepen their insight by utilizing resources such as Blackboard, computer generated animations, and various interactive media. As successful completion of the course is dependent on

test-taking skills, attendance, participation, and efficient time management, students are exposed to the basic expectations of professionalism.

Later, the faculty involved in teaching various courses contributed to a huge test bank, and the course coordinators selected the most appropriate questions after student learning outcomes were aligned with the GenEd proficiencies. These faculty-generated questions provide the ownership and commitment integral to the process^{5,8,9}. Faculty ranked the selected questions and the course coordinators narrowed down the list to 25 common final questions that reflected the student learning outcomes initially in BIO 23/24 and 11/12, and then later in other courses such as BIO 21, 22, 28 and the Medical Laboratory Technology courses.

Common Questions were designed to support students' learning by encouraging students to engage in learning behaviors that bring about deep rather than surface learning, such as recall and identification. This process took two semesters for faculty to arrive at full agreement on the questions selected. Once the agreement was met, the common questions were embedded into the final cumulative exam. Biology faculty were allowed to use 50-75 instructor-specific questions in addition to the 25 common questions.

Our next step was how to evaluate student learning specifically with reference to SLO's. The faculty decided to use Scantron sheets and the Scantron item analysis as tools to grade and analyze the common questions. The faculty picked their benchmark; the actual measurement of group performance against an established standard or performance, such as 70%. This meant that at least 70% of the students in the group were expected to answer that specific question correctly.

Gen-Ed Proficiencies	Related Terminology
Communication	Reading, writing, listening and speaking to find, interpret, and communicate information in various modes, including aesthetic, statistical, symbolic, and graphic
Reasoning and Analysis	Abstract reasoning, including the ability to analyze, interpret, evaluate and integrate information; apply the results; and formulate and solve
Personal Growth and Professional Development	Continue self-development to examine personal values and civic responsibilities. Navigate college and career requirements with academic, personal, and professional integrity and accountability
Scientific Method	Use the scientific method to understand the natural and physical concepts
Information Literacy	Use information technology to support professional and academic careers
Mathematical Methods	Use mathematics/statistics to solve problems

<i>Specific Student Learning Outcomes –Bio 24</i>	BCC General Education Proficiencies
1. Recognize the anatomical structures, explain physiological functions, and recognize and explain the principle of homeostasis applied to circulatory, lymphatic, and immune systems	Reasoning and Analysis
2. Recognize the anatomical structures, explain physiological functions, and recognize and explain the principle of homeostasis applied to the respiratory system	Reasoning and Analysis
3. Recognize the anatomical structures, explain physiological functions, and recognize and explain the principle of homeostasis applied to the urinary system	Reasoning and Analysis
4. Recognize the anatomical structures, explain physiological functions, and recognize and explain the principle of homeostasis applied to the digestive system	Reasoning and Analysis
5. Recognize the anatomical structures, explain physiological functions, and recognize and explain the principle of homeostasis applied to the reproductive system	Reasoning and Analysis
6. Identify and summarize the steps of the scientific method and recognize their role in the context of a laboratory experiment	Reasoning and Analysis, Scientific Method

This process of automatic implementation of the assessment questions and collection of data follows these steps:

Course coordinators e-mail the common questions along with the scoring instructions to faculty teaching the course 3 weeks prior to final exams.

The department chair and the course coordinators explicitly communicate the expectations from the faculty in department meetings and via email reminders from the department office in a memo regarding Final Grades Submission procedures. Faculty are expected to submit their grades, attendance rolls, and their assessment data in a timely manner.

Faculty grade and assess the common question scores based on the benchmarks using the item analysis sheets.

Faculty submit assessment data to course coordinators who compile the data and generate figures and tables reflecting the assessment results of the courses at that semester. Results are presented on the 8-Point Planning & Reporting Assessment Form developed by the College's Assessment team. Later, the form is sent to the College Assessment Team for further analysis.

Second Principle: Systemic

The Biology Department's second guiding principle is that the assessment process should be **systemic**. The assessment plan must provide for a methodical assessment process⁷. In other

words, assessment of student learning outcomes must be consistent and orderly over time. It should not be "once and done" event. For example, if a college is assessing critical thinking, it should be assessed regularly, using uniform tools and a steady schedule—which does not necessarily mean that testing should be done every year¹.

The assessment process is a systematic collection, use and review of data¹⁰. The instructors should concentrate on these questions in the process of assessment.

Can our students achieve meaningful learning from individual courses and transfer the knowledge into a sequence of courses?

Do our students possess the knowledge, skills, and experiences a graduate should possess?

Biology is a specific discipline arbitrarily spread over different courses; therefore, what an assessment reveals in one course will often speak to and affect content in the sequences of courses. For example, an assessment of Anatomy and Physiology I will not only affect the content and/or delivery of that course, but will often influence other courses in the sequence, such as Anatomy and Physiology II and Microbiology & Infection Control, benefitting the discipline as it is practiced at the department level⁷.

In Anatomy and Physiology I and II, faculty focus on the question, "What can a student do after completing the course guided by general education or basic skills?" Our aim is to make sure that students not only master the content, but develop competencies including basic skills, tools or ways of thinking and working as a result of completing the Anatomy and Physiology classes.

Table 3. A sample of 8-Point Planning & Assessment Form from Bio 28 in which Student Learning Outcomes Aligned to BCC's General Education Proficiencies. Assessment Vehicle, Scoring Tool, Benchmark, Sample Size, Results and Action Plan are also shown. The report indicates the high participation of faculty in the assessment processes.

8-Point Assessment Template							
Department: Biological Sciences		Chair: _____	Preparer(s): Course coordinator		Semester: Spring	Year: 2015	
1. Course Assessed	2. Course Outcome Aligned to BCC's General Education Proficiencies	3. Assessment Vehicle: Essay, Speech, Performance, Multiple-choice Questions, etc.	4. Scoring Tool (Rubric, Scantron, other.)	5. Benchmark	6. Sample Size/ Pool Size	7. Results	8. Action Plan (Please fill in "One-page Assessment Report" and send to Assessment Office)
BIO28	Mathematical skill /Integrating themes, Demonstrate understanding of scientific method	Q4,Q5,Q19, Q25	Scantron	70%	87.5 % sections Reporting	60.4	Provide more learning opportunities. Incorporate more Interactive Learning Resources.
BIO28	(Interaction and impact of microorganisms and humans) 1. Describe the valuable vaccines and products made with genetically engineered microbes. 2. Demonstrate control of microorganisms through Immunology, physical and chemical methods. 3. Recognize the importance of infection control in the prevention and treatment of infectious agents. 4. Summarize the role of the nurse in properly collecting a clinical specimen for microbiological analysis. 5. Describe host defense mechanisms that provide humans with nonspecific and specific immunity— <i>Reasoning and Analysis</i>	Q8,Q11,Q12 , Q13,Q16,Q17, Q18,Q24	Scantron	70%	87.5 % sections Reporting	76.2	Provide more learning opportunities. Incorporate more Interactive Learning Resources.
BIO28	Interaction and impact of microorganisms and humans 1. Define terms relating to epidemiology. 2. Identify microbial agents (bacteria, viruses, fungi) that are associated the various human body systems; respiratory, gastrointestinal, skin, nervous and urogenital. 3. Identify microbial agents (bacteria, viruses, fungi) that are associated the various human body systems; respiratory, gastrointestinal, skin, nervous and urogenital. 4. Assess the impact of microbial genetics on humans and the environment. 5. Describe host defense mechanisms that provide humans with nonspecific and specific immunity— <i>Reasoning and Analysis</i>	Q10,Q14,Q15, Q20,Q21,Q22,Q23	Scantron	70%	87.5 % sections Reporting	69.5	Provide more learning opportunities. Incorporate more Interactive Learning Resources.
BIO28	Microbial Cell Biology 1. Compare and contrast the differences between eukaryotic organisms as studied in previous BIO courses to prokaryotic organisms. 2. Compare and contrast the cell wall of the gram positive and gram negative bacteria 3. Discuss the phases of a typical growth curve— <i>Reasoning and Analysis</i>	Q1,Q2,Q3	Scantron	70%	87.5 % sections Reporting	68.1	Provide more learning opportunities. Incorporate more Interactive Learning Resources.
BIO28	Microbial Genetics 1. Assess the impact of microbial genetics on humans and the environment 2. Discuss genetic transfer methods that allow bacteria to convey information from one to another. 3. Explain how genetic mutations lead to antimicrobial resistance— <i>Reasoning and Analysis</i>	Q6,Q7,Q9	Scantron	70%	87.5 % sections Reporting	54.6	Provide more learning opportunities. Incorporate more Interactive Learning Resources.

In Anatomy I (BIO23), students are expected to demonstrate their knowledge of the topics covered by defining, listing, analyzing, and describing relevant information. Secondly, students are required to distinguish similar or related sets of information based on acquired knowledge demonstrating their comprehension and analytical skills. Thirdly, students are constantly led to extend and apply the basic knowledge for a greater and more active understanding of the topics explored. The introductory lectures in Anatomy I explore the human structure by defining and listing components such as atoms, molecules, cells, tissues--in general, providing a sense of structural hierarchy, and general chemistry. Then the following lectures focus on some of the structures and systems, including bone, muscular, nervous, endocrine and skeletal systems.

Anatomy II (BIO24) provides students information on how different organ systems work physiologically in the human body and the malfunctions/diseases related to these systems. Some of these systems include the circulatory, respiratory, and urinary and reproductive systems. This knowledge builds on to the concepts covered in Anatomy I, so that at the end of these interrelated courses, students will have covered the entire hierarchy of life, from matter to organ systems and to an organism. By relating these concepts to common diseases of the various systems, students are more engaged in class and have a better understanding how knowledge garnered through Anatomy and Physiology will be relevant to their future allied health careers.

The major goal of Microbiology and Infection Control (BIO 28) is to introduce students to infection control, host microbe interactions, illnesses by organ system,

and prevention of disease transmission. Students are required to use the knowledge gained in BIO23/BIO 24 to enhance the understanding of foundational concepts in (BIO28) Microbiology and Infection Control. For example, students are expected to deepen their educational experience by discussing the differences between eukaryotic organisms as studied in BIO 23/24 to topics covered in BIO28 such as prokaryotic organism's cell structure, comparing and contrasting the four major groups of infectious agents: bacteria, viruses, fungi and parasites. Additionally they learn to associate and identify microbial agents (bacteria, viruses, fungi, parasites) that inflict illnesses on various human body systems (something they learned in BIO23 and BIO24) and understand the control of microorganisms through immunological (learned in BIO 24), physical (learned in BIO23) and chemical methods. Course Specific SLOs are designed around the overlapping concepts in these courses, since BIO11/12 and BIO23/BIO24 are prerequisites for BIO28 (Table 4).

To ensure that students are meeting our expectations, we regularly perform evaluative assessment on their understanding of the subject matter through surveys, quizzes, random questions in class, and end-of-semester common finals exams as discussed earlier. In general, assessment is the process used to evaluate how well students have mastered the outcomes of a course, program or college core competencies. Assessment of BIO 23 examines how well students are prepared to master the content in BIO 24; assessment of BIO 24 examines how well students have developed competencies to transfer the knowledge they gained to other courses or curricula such as BIO 28.

Table 4. Overlapping Student Learning Outcomes in BIO 23, 24 and 28 sequence

BIO 23	BIO 24	BIO 28
1. Explain basic cellular functions such as protein synthesis, cellular respiration, DNA replication, and cell division.	1. Use the concepts learned about cellular structure, and histology to understand and explain the interrelationships within and between anatomical and physiological systems of the human body.	1. Explain and compare prokaryotic cell structure with eukaryote and be able to relate the cellular structures to their functions. Cellular respiration to explain why certain microbes are aerobic and others are fermentative or anaerobic. Explain mutations and development of drug resistance.
2. List, describe, and differentiate how things enter and leave cells (active and passive methods of transport across membranes).	2. Use concepts and mechanism of cellular exchange with their environment to understand and explain the interrelationships within and between anatomical and physiological systems of the human body.	2. How endocytosis and exocytosis comes in to play during host microbe interaction and disease development. What is the role of cell surface structures in adhesion of pathogens to target cells and antigen antibody interactions, use the knowledge obtained about protein synthesis to explain antibody production.
3. List, identify, and classify the cellular organic macromolecules, specify the monomers for each, and explain their relevance to human structure and function and	3. Use anatomical knowledge to predict physiological consequences, and use knowledge of function to predict the features of anatomical structures.	3. Use the concepts of anatomy and physiology learned in A&P part II to understand physiological changes caused by pathogens (signs and symptoms).
4. Explain the principle of homeostasis applied to the integumentary, nervous, endocrine, muscular and skeletal systems	4. Recognize and explain the interrelationships within and between anatomical and physiological systems of the human body. Synthesize ideas to find a connection between knowledge of anatomy and physiology and real-world situations, including healthy lifestyle decisions and homeostatic imbalances.	4. Immunological responses, Homeostasis, fever development, toxemia, acidosis and alkalosis induced by infectious disuses.
5. Identify and summarize the steps of the scientific method and recognize their role in the context of a laboratory experiment.	5. Demonstrate laboratory procedures used to examine anatomical structures and evaluate physiological functions of each organ system.	5. Continue to demonstrate Laboratory procedures collect and interpret data. Identify and summarize the steps of the scientific method and recognize their role in the context of a laboratory experiment.
6. Interpret graphs of anatomical and physiological data.	6. Interpret graphs of anatomical and physiological data.	6. Interpret epidemiological graphs and graphs of microbial life cycle, as affected by nutritional and environmental stimuli.

Systemic also refers to the actions of faculty who regularly perform outcomes assessment. In doing so, they expand on the department's conscious evaluation of how students are meeting or falling short of faculty-designed learning outcomes. In other words, "systemic" supports instructors' teaching by providing timely information about our students' learning. This also helps promote within faculty a more student-centered teaching approach and creates an engaged classroom environment which facilitates learning and knowledge retention. Even when the results of assessment are disappointing, as they sometimes are, they carry valuable information; that information speaks directly to the problem of student learning and provides a common goal for our faculty: Success of our students⁷.

Third Principle: Sustainable

The assessment process must be **sustainable** to embrace a culture of evidence-based practices that strive for continued quality improvement. One challenge in sustaining continual assessment at any level is that assessment must be built into the teaching philosophy. Assessment should be a counterpart to teaching, not deemed a mandatory task being imposed on faculty^{7,8,9}. When used together, teaching and assessment create a powerful tool for student learning.

One requirement to achieve a sustainable assessment culture is, of course, faculty participation and improving faculty expertise in choosing assessment techniques to match content-specific learning outcomes and evaluate student learning¹¹. Faculty members are the link between the knowledge base of the discipline and students acquiring that knowledge. Faculty members know their

subject matter well enough to determine the enduring concepts, skills, abilities, and habits that are essential to the discipline⁴. Moreover, assessment should be ongoing, not episodic^{5,12,13}. The Biology Department has been successful in sustaining rigorous assessment because the department chair and faculty share the belief and experience that successful student learning requires continual assessment⁷. Institutional ownership is an integral part of a sustainable assessment culture¹⁴, and in the case of assessment of student learning, leadership and faculty commitment to the process may be more important than administrators and program managers¹⁵. Faculty development programs are effective tools to engage faculty to reconstruct their curriculum around significant learning outcomes and authentic assessment strategies.

The College offers ongoing professional development programs to elevate faculty and staff competence through a series of higher-level assessment workshops for academic and non-academic programs. By doing so, BCC demonstrates its commitment to assessment and raises expectations among faculty and staff. In fact, two of the Biology faculty serve on the College Assessment team and are involved in conducting assessment workshops. They also keep the Biology department continually informed about new implementations brought about by the College Assessment Team. The workshops make clear that assessment is important and accessible, lead to conversations about student learning among faculty from different departments, encourage faculty to use the language and ideas of assessment, and help faculty gain competence and confidence¹. Ongoing professional development maintained by the College enables faculty

and staff to realize the importance of assessment as being part of their teaching vocation. Additionally, institutional involvement plays an essential role towards achieving a sustainable assessment culture by providing leadership, interdepartmental communication, and opportunities of evaluation of assessment processes by external accreditation agencies as reported by other studies⁴.

Recently, the College has focused on assessing all of its academic and non-academic programs, and formed two separate assessment councils with representation from all programs on campus. A linked series of workshops conducted by the College Assessment Team and Office of institutional Research guide and aid faculty members in evaluating their courses and programs. The Biology Department has an ongoing commitment to complete its program level assessment plans for improvement, growth, and accountability.

Fourth Principle: Meaningful

The fourth guiding principle is that the assessment process be **meaningful**. "A culture of assessment can guide meaningful change on a continual basis"^{4,16}. In order to track the progress of assessment toward sustainability the Biology Department needed to establish a vision with intended goals that would move the assessment process forward in a meaningful way, a necessary but challenging task. This challenge relates to the content of assessment and the need to make it systemic with a practical focus on subject-level learning outcomes and communicate with the faculty teaching these courses. Volkwein¹⁷ asserts it is not sufficient only to do

assessment; findings of the process must be used to draw meaningful conclusions. In order to achieve that goal we needed to draw conclusions from benchmarks and to come up with responsive tools to address why students were not meeting the outcome goals. So all faculty are expected to submit their course assessment reports to respective course coordinators. Course coordinators compile a final report which includes information on individual assessment questions as well as SLOs whether the benchmark (70% correct response) was met or not. In order for assessment to be meaningful the assessors need to "close the loop." This involves examining the results of the assessment, determining their significance, and making changes in the next iteration of the course⁷. We ensure the participation of the entire faculty involved while making revisions, to secure their firm commitment to adopted remedies and resulting actions. This is an ever evolving process; sustainability results from ongoing assessment which should involve developing a capacity for repeated measurements to determine trends, readjust goals and remedies as new data-driven insights are gained¹⁸.

We have put forth significant effort as a department to ensure that what we learn from assessment outcomes is collective for all faculty involved and that faculty feedback is most valued in making adjustments and proposing remedies. Assessment results of all the courses have been continually studied and discussed in the Biology department and individual course meetings at different levels since 2007.

The common questions are reviewed each semester. The assessment results, including students' deficiencies and competencies revealed by the assessment are discussed. Based on the

results, faculty describe how we would change or improve the teaching of this assignment/topic or re-organize content of the question(s). Specifically, faculty share the results and analyze them by looking at how many students missed what level of question on what specific topics. Based on those results, faculty address the following questions:

Are we satisfied with how students performed?

Is there anything we could do differently to try to ensure that more students can answer the assessment outcomes questions correctly?

To make the process meaningful we have to determine trends so that we can readjust goals and remedies based on the new information unveiled by data analysis. For example, the faculty identified the most difficult concepts for students in BIO 23, 24 and 28 through data analysis (Table 5).

Transfer of knowledge across disciplines is a continuing challenge at the College; BCC's commitment to general education is one attempt to address it. Improvements in assessment efforts contribute to the general transferability of knowledge from one subject to another, and thus from one discipline to another. The best classroom assessments also serve as meaningful sources of information for faculty, helping them identify what they taught well and what they need to work on. As a result of our assessment efforts we were able to identify the most difficult concepts in the sequence of courses mentioned earlier, BIO 23, BIO 24, and BIO 28. We continue to pay special attention to these problem areas to improve our teaching and learning strategies, and to help our

students' transfer of knowledge between common topics of these series of courses. We believe these are first steps in establishing our assessment culture.

Revising our assessment tools, goals and remedies helps successfully to close the loop without which assessment cannot and will not lead to improving the quality of outcomes or our students' success, a hallmark indicator of pedagogical interventions. The department's assessment of student learning outcomes, whose results are sometimes encouraging, sometimes disappointing, but always revealing, continue to inform curricular changes and encourage student-centered teaching practices. Another way to achieve sustainability of the assessment process and to make it meaningful has to do with clearly assigned responsibilities. At BCC we have faculty, course coordinators, department assessment coordinators and institutional assessment leaders with clearly defined roles and expectations⁷.

Conclusion

By regularly discussing assessment and pedagogy as parallel components of teaching and learning, faculty response in the Biology Department has become increasingly enthusiastic. We are acutely aware that we are taking much smaller steps than we would like, but these small steps allow for a slow but meaningful "assessment habit" to take hold. These measures have a positive, demonstrable impact on instructional practice. Assessment has been introduced and practiced in all academic programs and faculty have bought into the concept and understand its benefits in concrete, practical terms. Still, much training remains to be done to overcome pockets of resistance and to establish assessment

Table 5. Most difficult concepts identified after assessing the common final exam results of each course

BIO 23	BIO 24	BIO 28
Cellular Respiration (ATP synthesis)	Blood osmolarity	Microbial cell structure, Respiration
Genetics (Transcription, Translation)	Blood Flow (Volume and Pressure relationship)	Microbial genetics and, role of mutations in drug resistance
Muscle twitch and tension	Acid-base balance	Infection control
Action potential	Digestive system (Role of pancreas in digestion)	Terminology in host Microbe interaction, Immunology
Endocrine system	Male and female reproductive hormones	Diagnostic Microbiology, Chemotherapy
Protein synthesis	Heart (Cardiovascular system), Respiration, (Respiratory system)	Microbial growth cycle

as routine academic practice.

The next phase of BCC's assessment efforts will address the latter and ensure the "routinization" of assessment by integrating it into periodic department self-study and program review. Protocols to focus on self-studies and reviews are dependent on continued information gathering and analysis that supports strengthening institutional understanding of student learning. Assessment data should be organized and archived; lessons learned along the way from analyzing assessment data should lead the way to improved teaching and learning across the curricula, programs and beyond.

Acknowledgment

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Correction: The following abstract for a Member Presentation by Dr. Patrick Field of Kean University was inadvertently omitted from the Winter Issue

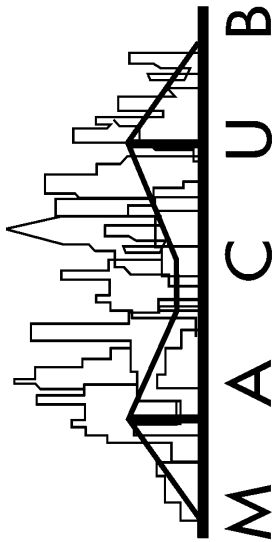
Clinical Reasoning Assessment of Case Study Practice in Gross Anatomy. Patrick R. Field, Kean University, Union, NJ.

A Qualtrics survey involving clinical reasoning revealed data that supports the use of clinically-based paper case studies in the Gross Anatomy classroom/laboratory towards preparation for the clinical environment, specifically the hypotheses based reasoning model known as hypothetico-deductive reasoning (Geisler and Lazenby, 2009), the most basic form of clinical reasoning. The survey was distributed to previous students that had either taken my graduate level Human Gross Anatomy, within the Masters of Occupational Therapy (OT) program, or my undergraduate level Basic Gross Anatomy, a requirement for the BS in Athletic Training (AT); and had graduated between AY 2005-2010. Participation ranged from 17 % (19/112) of OT graduates to 33 % (9/27) of AT graduates. When clinicians were asked to rank components of the paper case studies towards mastery of clinical skills, components similar to the steps of the SNAPPS process of medical reasoning (Wolpaw et al 2003; Wolpaw et al, 2009), using a Likert scale of 1-4 (1 being “not useful” and 4 being “very useful,”), statistical data revealed that participants greatly valued the early exposure to the elements of the clinically-based case study. Highly significant ($p < \text{or equal to } 0.001$) correlations were also found between some of the components, reinforcing and complying with the steps in the SNAPPS process: history and gait analysis; physical symptoms, manual muscle testing, sensory testing and diagnosis/working with a diagnosis; manual muscle testing, sensory testing, designing a rehab plan; cognitive symptoms and incorporating mental status into the prognosis; designing a rehab plan and incorporating mental status into the prognosis; and anomalous presentation and cognitive symptoms and incorporating mental status into the prognosis.

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