



## The Efficacy of a Multi-Modal Communication Model on Campus Lifestyle Behaviors and Biometric Measurements

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### Abstract

The college environment possesses a unique opportunity to influence the lifestyle practices of a large yet diverse population, including students, staff, and faculty.

**Objective:** This study served to determine the effectiveness of a multi-modal approach on campus health behaviors and biometrics.

**Participants and Methods:** Fifty individuals from a campus community participated in a six-month nutrition and fitness education program. Electrolipography and lifestyle behavior surveys were completed by the participants before and after the program. Live presentations and a comprehensive website including videofiles, newsletters, and nutrition and fitness tips were provided.

**Results:** T-tests revealed the intervention program significantly affecting variables such as fruit and vegetable consumption, activity levels, participation in resistance training, and amounts of satisfactory sleep.

**Conclusion:** This multi-modal approach was effective in raising awareness, informing behavior, and promoting wellness in a campus community.

**Keywords:** Campus; Health; Nutrition; Fitness; Behavior

### Introduction

Obesity rates have more than doubled in adults since the early 1980s [1]. Increases in the prevalence of overweight and obesity continue to rise, increasing the socioeconomic burden imposed by obesity-related diseases such as heart disease, hypertension, stroke, and type 2 diabetes [1,2]. Results of the 2007-2008 National Health and Nutrition Examination Survey (NHANES) estimate that 34.2% of individuals over the age of 20 are overweight, 33.8% are obese, and 5.7% are extremely obese (CDC, 2010). The American College Health Association's National College Health Assessment Reference Group Summaries for the study period: Fall 2010, Spring 2011, and Fall 2011 reveal rates of overweight and obesity among college students at 32.5%, 32.4%, and 34.1% respectively (NCHA, 2012). Conclusions based on the Final Review of Healthy People 2010 reveal little to no progress was made in the Focus Area of Nutrition and Overweight with the exception of Calcium Intake. In fact, rates for many of the objectives in the Nutrition and Overweight Focus Area have moved further away from established tar-

gets (CDC, 2012). Racette, *et al.* (2005) note that the "Promotion of healthy lifestyle behaviors early in college may have long-term benefits throughout adulthood that would serve to reduce the rising incidence of physical inactivity, overweight, and obesity in our society" (p. 250). Academia offers a unique opportunity to educate and raise awareness among a diverse group of individuals, and to promote the diffusion of information into the families and respective fields of the individual participants. This study focused on the impact of a fitness and nutrition program on a campus community, including students, staff, and faculty. The program served to raise awareness, inform behavior, and to promote overall wellness with special emphasis in the areas of nutrition, exercise, and fitness. The primary goals of the program and study were to promote health awareness and education; and to develop a model for campus wellness programming.

Living or working in the college environment can be detrimental to health and wellness without appropriate skills in stress management, time management, and lifestyle choices. The use of food and/

or alcohol as a coping mechanism is not uncommon in the presence of emotional and/or environmental stressors [3]. Both students and staff/faculty have to determine how to manage the many time demands in academia in addition to the numerous opportunities for convenience foods, unhealthy choices in the café, and fast food or pizzeria-type food options in close proximity to campus. While many of these companies/organizations offer choices that can be a part of a healthy lifestyle, many individuals are not aware of the options or do not know how to order to acquire the most nutrition benefit from these options. It is crucial that opportunities for campus awareness and education be created to promote the quality of life, long-term health, longevity, and productivity of students, faculty, and staff [4].

The program and research study were approved by the Institutional Review Board of the university. The university is a private Midwestern liberal arts institution with approximately 2300 students, bachelor and master's degree programs, traditional and non-traditional students, and a student to faculty ratio of approximately 11 to 1.

## Methods

Students, staff, and faculty were invited to participate in an education program and research study via broadcast email, regular email service, and a campus-wide wellness kick-off event "Live Well. Be Well." The campus wellness committee (faculty and staff) scheduled a variety of activities around campus for the kick-off including an a.m. walk hosted by faculty and students in the park adjacent to campus, a bike ride with the president in the park, a session of cross-fit hosted by the vice president of academic affairs in the center of the campus, basketball in the gymnasium with faculty, Tai Chi in the theatre's dance studio with faculty, and Pilates in the fitness center with faculty. Activities were strategically scheduled throughout the day to promote participation and campus awareness. The student wellness committee provided educational handouts, and information on the nutrition and fitness wellness program in the campus quad.

Two emails (regular email and broadcast email) were sent inviting students, staff, and faculty to join a nutrition and fitness program and research study. A two and a half week enrollment period was allocated. A one-week window was created after the enrollment deadline for individual body composition testing. Online Doodle was utilized to schedule initial body composition and follow up body composition appointments, encouraging participants

to choose one 20 minute slot from the available times posted. Four measurement stations were created to collect participant data. The stations included an anthropometric measurement station, a station for assessing height and body weight, a station to perform the Electrolipography measurement, and a station to complete the lifestyle behavior survey in private. The surveys were provided to enrollees to complete anonymously during the time of the initial body composition testing, and again at follow up body composition testing (see Table 1). A box was created, sealed, and secured for survey submission to promote participant privacy and anonymity. The Bio Analogics Electrolipograph was utilized to assess pre-program body composition and post-program body composition. The Bio Analogics Electrolipograph has a Standard Error of 2.8% when compared to the hydrostatic tank [5,6]. The body composition equipment and scales were calibrated before the initial and repeat body composition measurement testing; and, researcher roles in the data collection process remained consistent from pre-program to post-program to promote validity and reliability. Participant body composition and Electrolipography data were entered into the BioAnalogics software program, and individual body composition reports with corresponding nutrition plans were printed [7-10].

An electronic blackboard site, segmented into weeks and topics, was created exclusively for enrollees. The participant's right to withdraw from the program and/or study at any time was verbalized during the first presentation of the program, and communicated in writing on the program's electronic site. Each week's postings included a nutrition tip of the week, a fitness tip of the week, a relevant newsletter, a link to record pedometer tabulations and weekly exercise logs, and a link to a question and answer forum. Live presentations were provided over the lunch hour via a total of two faculty members and two students. The majority of presentations were limited to one individual speaker, and students were supervised by a faculty member in the planning and delivery of their presentations. Presentations were videotaped and subsequently loaded onto the blackboard site as videofiles for observation if attendance to the live presentation(s) was not feasible. Presentations and corresponding videofiles were not offered when school was out of session including Thanksgiving recess, Christmas recess, and New Year's recess. Nutrition tips, fitness tips, and links to record pedometer steps/log exercise remained available throughout the recess periods. Newsletters were available incorporating topics not addressed directly in the weekly topics but relevant to promoting overall participant success.

<p>1. How often do you eat fruit and vegetables (Please circle)</p> <p>Less than one ounce daily/Never</p> <p>Less than 3 times/day</p> <p>Less than 5 times/day</p> <p>5+ daily</p> <p>2-3 times/day</p>	<p>7. How often do you participate in planned weight training? (Please do not include the activities in #6 in your response).</p> <p>Never</p> <p>Daily</p> <p>6+/week</p> <p>5+/week</p> <p>4+/week</p> <p>3+/week</p> <p>2+/week</p>
<p>2. How many meals (not snacks) do you eat a day?</p> <p>One meal/day</p> <p>Two meals/day</p> <p>Three meals/day no balance</p> <p>Three somewhat balanced meals/day</p> <p>Skip meals frequently/no routine</p>	<p>8. During the past 30 days, how many days have you felt you did not get enough rest or sleep?</p> <p>No days</p> <p>1-14 days</p> <p>15-29 days</p> <p>30 days</p> <p>I don't know/not sure</p>
<p>3. What are your snacking habits?</p> <p>One snack daily</p> <p>Two snacks daily</p> <p>3 snacks daily</p> <p>Eat throughout the day/no routine</p>	<p>9. Do you find yourself eating more when .... (Circle all that apply)</p> <p>Sad</p> <p>Lonely</p> <p>Bored</p> <p>Stressed</p> <p>Food is lying around</p> <p>Only when hungry/mealtime</p>
<p>4. How would you describe your physical activity level?</p> <p>Physically inactive</p> <p>Irregular/not sustained      Regular/not intensive</p> <p>Regular/intensive</p> <p>Unknown</p>	<p>10. I have... (Please circle all that apply)</p> <p>Asthma</p> <p>Diabetes</p> <p>Heart Problems</p> <p>High Blood Pressure</p> <p>Arthritis</p> <p>Lung Disease</p> <p>High blood cholesterol levels</p> <p>Other _____</p>
<p>5. Are you limited in any way in any activities because of an impairment or health problem?</p> <p>Yes</p> <p>No</p> <p>Don't know/not sure</p>	
<p>6. How often do you participate in planned aerobic physical activity (walking, running, biking, gym). Please do not include weight lifting in your response.</p> <p>Never</p> <p>Daily</p> <p>6+/week</p> <p>5+/week</p> <p>4+/week</p> <p>3+/week</p> <p>2+/week</p>	

**Table 1:** MU Health Beat Program Pre-Program and Post Program Survey.

The education program consisted of twelve presentations during the academic year: three during the month of October, three during the month of November, one during the last week of January, four during the month of February, and one during the first week of March. The body composition reports and nutrition plans were distributed to the individual participants at the initial live presentation. The initial presentation included how to interpret the body composition reports; and, the individualized nutrition plan. The individualized nutrition plans were computed by the BioAnalogics software program in response to the participant's body fat percentage, body fat goals, and percentage of macronutrients entered for the individual. A daily summary of recommended calories and grams of each of the macronutrients (carbohydrate, protein, and fat) was provided to assist the participant in meeting individual goals. Individual plans consisted of 50-60% carbohydrate, 15-20% protein, and 25-30% fat with higher ranges of carbohydrate reserved for athletes participating in high-intensity sports or endurance sports. Expense-free online calorie tracking programs were encouraged to assist the participant in comparing recommended intake for calories and macronutrients with actual intake for calories and macronutrients. Individual plans were modified within the BioAnalogics software program at the request of two participants striving for a more athletic body composition with personal goals to compete in special events (i.e. triathlon or 5 kilometer run). The Bio Analogics program also distributes the designated grams of carbohydrates, protein, and fat conducive to individual goal achievement into meals and snacks in the form of exchanges with accompanying breakdown of foods and portion sizes considered as one exchange (meat, starch, fruit, milk, vegetable, fat). Among the presentations, eight were related directly to nutrition, two addressed aerobic and/or resistance training, and one addressed overall health and wellness. Session titles included (1) Program Introduction and Why are we here? (2) Reading labels and Grocery Shopping for Longterm Health, (3) Carbohydrates – Fueling for Energy and Overall Health; Dispelling Myths, (4) Dining Out Healthily, (5) Living An Active Lifestyle, Cardiovascular Activity, (6) Holiday Tips to Stay on Track during the Holiday Season, (7) Cooking and Eating for Heart Health, (8) Living an Active Lifestyle, Resistance Training, (9) Emotional and Environmental Triggers and Weight Control, (10) Fad Diets and Other Over-the-Counter Diet Programs. Is it Too Good to be True? (See table 2).

An indoor sports center is located at the periphery of campus, and is affiliated with the university. Full time students receive free membership upon enrollment. Staff and faculty can join the indoor sports center at 50% of customary fees. Opportunities for exercise

included a group walk in the park on Tuesday and Thursday mornings until winter weather prohibited the walk. The two presentations that related to aerobic or resistance training educated the participants on how to begin an aerobic and/or resistance training program. Additionally, three day passes and the opportunity to meet on an individual basis with the exercise physiologist (adjunct faculty member) at the indoor sports center was also provided. The opportunity was provided to assist the participant in designing an exercise regimen (aerobic and resistance) whether it be as a current or new member of the indoor sports center, or a regimen for home use.

Pedometers were provided at cost to promote awareness of individual participant activity levels. Participants were encouraged to determine their baseline daily number of steps by wearing the pedometer for one week, tallying the number of steps, and dividing the number of steps by seven. Participants were encouraged to gradually increase their activity to an average of 10,000 steps a day, with the long-term goal of a minimum of 10,000 steps a day for long-term health. Bulk emails were sent periodically to study participants throughout the education program to spark enthusiasm among program participants and to inform participants of events on campus that were conducive to promoting overall participant success. Doodle was utilized to schedule the participants for follow up testing. Repeat body composition testing commenced one week following the last presentation. The follow up body composition measurement testing window was limited to the length of the initial body composition testing period, two and a half weeks. Enrollees were again provided with an anonymous survey at follow up body composition testing to assess changes in behavior from pre-program to post-program.

## Results

Sixty two individuals expressed interest in enrolling in the education program and study. Six of the 62 individuals did not show for their initial body composition testing appointment or enroll in the program or study. Another six individuals completed the body composition testing outside of the designated testing window, and participated in the education program; however, were not included in study's data. Fifty individuals actually enrolled in the education program and research study, including initial body composition testing. Three individuals withdrew from the program and study. One individual withdrew stating that that he/she had not officially participated in any part of the program after the initial body composition due to a lack of time. One individual withdrew due to having surgery toward the end of the program. The third individual

commented that he/she had gained weight over the holidays and had not participated in any part of the program past the initial body composition testing. An additional 18 participants were lost to attrition (did not schedule an appointment for repeat body composition testing). Twenty nine individuals completed both the initial

and repeat body composition testing and the pre-program and post program surveys. Among the 29 individuals who completed the post program body composition testing and survey, 60% were staff, 17% were students, and 23% were faculty.

Session	Session Content
Program Introduction and Why are We Here?	Body Composition Report Review; Nutrition Plan Review: Meal Plan with Grams Carbohydrate, Protein, Fat. Exchange System, Exchanges
Reading labels and Grocery Shopping	The Food Label: Serving size, Macronutrients, Micronutrients, Vitamin and Minerals, Putting Grams and Daily Values into Context of Individual Nutrition Plan
Carbohydrates: Fueling for Energy and Overall Health; Dispelling Myths	Complex and Simple Carbohydrates; Insoluble and Soluble Fiber; Role of Carbohydrates in Fueling Health and Performance; Dispelling Myths Related to Carbohydrates
Dining Out Healthily	Menu Lingo; Special Orders and Al La Carte; Substitutions; Eating Mindfully; Dining Out Italian, Chinese, or Mexican style. Restaurants and Best Bets; Fast Food. Alcohol Use
Living An Active Lifestyle, Cardiovascular Activity	Barriers to Exercise, Tips to Overcome Barriers, Beginning a Formal Exercise Program, and Progression. What is Cardio? Tracking and Accumulating Steps
Holiday Tips to Stay on Track during the Holiday Season	Host of the Party; Guest at the Party; Food Safety; Balancing Choices
Cooking and Eating for Heart Health	Keys to Heart Health: Blood Pressure, Nutrition Choices, Activity, Weight Control; Cholesterol and Triglyceride Levels; Other Helpful Tips
Emotional and Environmental Triggers	Why Do You Eat? Psychological versus Physical Hunger; Emotional Triggers; Environmental Triggers at Home and the Office; Managing Emotional and Environmental Food Triggers
Sleep Deprivation, Stress, and Overall Wellness	Symptoms of Physical and Emotional Stress; Appetite Hormones; Impact of Inadequate  Sleep and Stress on Health; Health, Wellness,  and Wellness Components
Fad Diets and Other Over-the-Counter Diet Programs, Is it Too Good to be True?	What is a Fad Diet? Why Fad Diets? What Constitutes a Fad Diet? Fad Diet Review

**Table 2:** Synopses of Session Content.

Live presentation attendance varied from 2 to 15 participants throughout the program. The average number of times the online site was accessed among participants who completed the program and research study (body composition testing and survey at the end of the study) was 82, while the individuals who did not complete the post program body composition testing and survey accessed the online site an average of 77 times.

Dependent T-tests revealed the multi-modal health communication program significantly impacted participant survey responses from entry to completion of the program for four of nine survey variables including (1) How often do you eat fruit and vegetables? (p = .003), (2) How would you describe your physical activity level? (p = .000), (3) How often do you participate in planned weight training? (.003), (4) During the past 30 days, how many days have

you felt you did not get enough rest or sleep? ( $p = .000$ ). Dependent T-tests revealed the multi-modal health communication program did not significantly impact participant responses from entry to completion of the program for four of nine survey variables including (1) How many meals do you eat a day? ( $p = .311$ ), (2) What are your snacking habits? ( $p = .076$ ), (3) Are you limited in any way in any activities because of an impairment or health problem? ( $p = .069$ ), and (4) How often do you participate in planned aerobic physical activity such as walking, running, biking, gym; Please do not include weight lifting in your response? ( $p = .943$ ).

Among the group findings, the group of participants ( $n = 29$ ) that completed the program lost a total of 98 pounds of body fat, 62% of participants lost centimeters (loss of 54.61 centimeters total) at site 1 (smaller portion of the waist) of the anthropometric measures; 61.5% lost centimeters (loss of 109.98 centimeters total) at site 2 (umbilicus) of the anthropometric measures; and, 6.8% shifted to a lower BMI class. Concerns included that 44% of participants lost some muscle mass; and, 24% of participants lost a muscle mass of 2 pounds or greater. While rates of resistance training improved, rates remained poor overall. While dialogue among participants suggested pedometer use was high throughout the program, documentation of steps in the designated link on the electronic blackboard waned from 56% at week one to 0% by week 9, and the logging of steps was poor overall. Participation (3.4%) in the weekly campus walks (Tuesday and Thursday 7 a.m. – 8 a.m.) was poor. Individual consultation (3.4%) with the exercise physiologist was also poor among individuals who enrolled in the program (6%) and individuals who completed the program (3.4%).

Post-program surveys revealed the following: (1) increases in fruit and vegetable consumption, (2) increases in consumption of more balanced meals, (3) increases in physical activity (resistance training and aerobic exercise, irregular and intensive vs. none), (4) declines in meal skipping, (5) declines in rates of days participants felt that they did not get adequate sleep, (6) declines in using food as a coping mechanism when lonely or stressed, (7) increases in only eating when it is meal time or when actually hungry, (8) increases in food consumption when feeling sad or when food is in close proximity (see table 3).

### Comment

Individual goals of participants centered around one of three themes: to lose weight, to increase muscle tone, and/or to learn how to live a healthier lifestyle. Among the participants, 3.4% reported a diagnosis of type 2 diabetes; 17.2% reported a diagnosis

of high blood pressure; 17.2% reported a diagnosis of hypercholesterolemia; 6.9% reported a diagnosis of hypoglycemia; 13.7% reported a diagnosis of asthma; 13.7% reported having problems with either back, neck, knee, and/or generalized pain (fibromyalgia); and, 34.4% reported activity limitations. Overall, the utility of the electronic site and supporting materials was well above expectations, and significantly greater than the attendance of the live presentations. Some participants attended both the live presentations and accessed the videofiles on the website for reinforcement of topic concepts according to participant comments during live presentations.

### Limitations

Participant attendance at the live presentations was greater in the fall semester versus spring semester. Reduced attendance rates may be attributed to a number of variables including harsh winter weather, extended duration of the program (October through March), and the need to move the delivery date from Wednesdays to Fridays to accommodate conflicts with student and faculty presenters with the change in academic semesters, and course schedules. Participant limitations due to reported health issues, 34.4%, may have also impacted outcomes related to physical activity and subsequent body composition. Degree of blood pressure control, glycemic control, and extent of bone disorders and/or associated pain may limit participant ability to follow a physical activity regimen, and the frequency and intensity of the exercise regimen. Conflicting student, staff, and faculty schedules (personal and university) were also a variable in the attendance of live presentations as well as the Tuesday and Thursday a.m. campus walks.

### Attrition in the program and study may have been in part due to Information

Technology's decision to upgrade to a newer version of the online blackboard. As a result of the changes in technology, participants had to access the online site a different route than the usual route (Old Moodle vs. Moodle) (student and faculty only). The visual reminder of the program was lost with the changes by Information Technology because the link to the program no longer appeared with the student or faculty member's current course load. Changes implemented by Information Technology personnel also resulted in the user having to enter the username a second time and subsequently a second password, making the log in process more cumbersome. The brevity of the body composition testing windows (initial and post program) in conjunction with the timing (post program measurement and spring break), may have also contributed to both low enrollment and program attrition.

	Pre-Program	Post-Program
<b>Daily Fruit and Vegetable Consumption</b>		
None	17.2%	6.9%
1-2 Servings Daily	20.7%	17.2%
2-3 Servings Daily	37.9%	37.9%
4 Servings Daily	10.3%	13.7%
5 or More Servings Daily	13.8%	24.1%
<b>Meals Eaten Daily</b>		
One Meal Daily	0.0%	0.0%
Two Meals Daily	27.6%	27.7%
Three Meals Daily/No Balance	24.1%	17.2%
Three Balanced Meals Daily	44.8%	58.6%
Skip Meals Frequently/No Meal Routine	3.4%	0.0%
<b>Current Physical Activity Level</b>		
Inactive	10.3%	0.0%
Irregular	20.7%	27.5%
Regular/Not Intensive	37.9%	37.9%
Regular/Intensive	20.7%	34.4%
Unknown	13.8%	0.0%
<b>Frequency of Aerobic Activity</b>		
Never	24.1%	20.7%
One each Week	0.0%	0.0%
Twice each Week	20.7%	20.7%
Three Times each Week	6.9%	10.3%
Four Times each Week	17.2%	20.7%
Five Times each Week	17.2%	13.7%
Six Times each Week	3.4%	3.4%
Daily	10.3%	13.7%
<b>Frequency of Weight/Resistance Training</b>		
Never	69.0%	51.7%
One each Week	0.0%	3.4%
Twice each Week	20.7%	27.6%
Three Times each Week	3.4%	6.9%
Four Times each Week	3.4%	10.3%
Five Times each Week	0.0%	0.0%
Six Times each Week	0.0%	0.0%
Daily	3.4%	0.0%

During the past 30 days, how many days have you felt that you didn't get adequate sleep?		
None	6.9%	6.9%
1-14 Days	62.0%	82.8%
15-29 Days	20.7%	3.4%
30 Days	10.3%	3.4%
Unsure	0.0%	3.4%
Do you find yourself eating when...		
Sad	3.4%	10.3%
Lonely	6.9%	3.4%
Bored	44.8%	44.8%
Stressed	48.2%	44.8%
Food is Laying Around	27.6%	37.9%
I only eat when hungry or at mealtime	20.6%	27.5%

**Table 3:** Survey Results (N=29)

**Conclusions**

Online site access rates suggest the online site (videofiles and supporting documents of topics) was an integral component of the program. The development of such online sites can serve as templates for future programming; however, occasional individual or group contact may help promote participant accountability with one participant commenting she lost motivation to continue in the program when the outdoor walks were discontinued due to the weather. While attempts to develop camaraderie among program participants for the purpose of creating opportunities (emails and postings on the site) for activity were unsuccessful in this particular program, other possibilities should be investigated.

While a significant number of participants who completed the post program body composition testing and survey lost centimeters, body fat, and/or demonstrated healthier behaviors suggesting reduced health risk, a significant portion of participants also lost muscle mass and did not incorporate resistance training as suggested into their regimen. The loss in muscle mass and findings from the lifestyle behavior surveys suggest that further education should be provided on (1) how to avoid the use of food as a coping mechanism, (2) how to avoid food as an environmental trigger; and, (3) the importance of resistance/strength training and aerobic exercise in a healthy lifestyle.

Considerations for future programming and increased participation include: (1) marketing the program more via email,

broadcast mail, campus radio, campus newspaper, campus events, student organizations, Greek organizations, (2) extending the enrollment period, (3) targeting certain populations more based on enrollment (i.e. male population with only four males enrolling at the beginning of the program, and only three completing the post program body composition testing and survey), (4) extending the post program testing to match the revised enrollment period, (5) providing more opportunities for exercise, and (6) the addition of various types of group activities and pedometer challenges to promote more walking, documentation of daily steps, and accountability.

While the participants who were lost to attrition did not convey that repeat body composition testing was a factor in not participating in the post program data collection, participants who did not complete the repeat body composition testing could have been asked if they are still willing to complete the post program survey. A more strategic approach to the timing and incorporation of additional group activities may foster greater group dynamics, group accountability, and heightened participant outcomes. Post program comments were positive and suggested that similar programs would be both welcome and beneficial to the same group of participants. A lack in agreement of when to provide the live programming existed; however, there was a consensus that the electronic site was a favorable alternative to the live presentations if participants could not attend any or all of the presentations due to other commitments.

Universities need to make a conscientious effort to promote wellness on campus, and to be proactive in campus health programming. The establishment of campus wellness committees (faculty, student, and faculty-student) can create unique opportunities for health education and health promotion, collaboration among disciplines, students, staff, and faculty. Students can become more equipped for entry-level careers when given the opportunity to put theory into practice during their undergraduate experience; and, should be given the opportunity for varying degrees of responsibility and leadership in campus health education and programming based on collegiate level, skills, and experience.

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