

A Kickstart to Smart Living in Undergraduate Engineering: Proposing Goals and Objectives for a First-Year Happiness and Well-Being Course

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A Kickstart to Smart Living in Undergraduate Engineering: Proposing Goals and Objectives for a First Year Happiness and Wellbeing Course

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Abstract

Background

Students in higher education report a multitude of mental health problems. The situation seems to have been exacerbated by the Covid-19 Pandemic. In undergraduate engineering education in particular, an overall stress culture prevails caused by high academic workload, sleep deprivation, higher self-expectations, and other factors that resulted in less time available for students to use directing their attention to their mental health and wellbeing (MHW). The prevalence of such situations has attracted recent calls for a serious effort to bring positive changes in engineering education culture.

Purpose

To support MHW and ultimately the success of undergraduate engineering students, the purpose of this study is to introduce a first-year happiness and wellbeing course by offering its learning goals and objectives. Specifically, the authors wish to exemplify and discuss the research process that informed the formation of the proposed course goals/objectives for such a course.

Design/Method

Semi-structured interviews of 8 undergraduate engineering students were conducted in the Fall of 2021 based on an earlier conceptualized framework of subjective wellbeing. Thematic analysis of the interviews was used to construct a 7 factors analytical framework of undergraduate engineering student subjective wellbeing and further identify 6 goals of a future happiness and wellbeing course. The 7 factors were also used to develop 7 open-ended survey questions that could be delivered to participants in a well-being study. Data on the 7 open-ended survey questions were then collected in the Spring of 2022 (N = 105). These results will be thematically analyzed to identify learning goals/objectives for the happiness and well-being course that could be delivered to engineering students. Following a “backward design” (Wiggins & McTighe, 1998) model for curriculum development, the identified goals/objectives will align with the discovered themes, treating them as outcomes, that the proposed course curriculum (objectives, assessments, learning experiences) will target. Krathwohl’s taxonomy of the affective domain will be used in developing the learning objectives corresponding to these goals/objectives.

Results

The seven-factor analytical framework guided the setting up of the following 6 learning goals for the proposed happiness and wellbeing course.

- 1) Foster faculty-student relations beyond the typical.
- 2) Flourish dependent and interdependent learning skills in students.
- 3) Support students’ efforts to access available financial resources.
- 4) Guide students to efficiently manage their assigned academic tasks.

- 5) Enable students to be healthy and contribute to an overall positive college environment.
- 6) Support student needs by equipping them with information retrieval skills.

The learning objectives for each goal were developed from the thematic analysis of the data collected in response to the 7 open-ended questions.

Conclusion

Based on multiple empirical studies, we propose that implementing a fully developed MHW course has the potential to equip first-year engineering students with skills that will positively affect their MHW. This will ultimately lead towards their persistence to graduate.

Keywords: course curriculum, engineering education, wellbeing, mental health, undergraduate

1. BACKGROUND

Presently, campuses are facing mental health and wellbeing (MHW) crises all over the nation [1]. Around 60% of college students across the nation qualify for the criteria to have one mental health problem at the minimum according to a study conducted on 373 college campuses [2]. The prevalence of COVID has worsened the MHW crisis [3] and exposed the ill-preparedness of our educational institutions to properly correspond to the MHW needs of their hosted students.

In undergraduate engineering, the MHW situation is not satisfactory as well. Higher levels of anxiety [4, 5], depression [4, 6, 7], stress [4-6, 8], and post-traumatic stress disorder [6] have been reported in undergraduate engineering education with COVID-19 exacerbating the already adverse MHW situation [9, 10]. A variety of causes including high academic workload [11-13], sleep deprivation [14-15], competitive nature of engineering programs [16], and other factors [17-19] have been attributed to the unsatisfactory MHW situation of undergraduate engineering students.

MHW literature in higher education in general [2, 3] and engineering education [20-22] in particular is calling for systematic changes to support a culture of wellness for students. To correspond to such calls and the present MHW crisis, educational institution leaders have started to think outside of the box and look towards new mechanisms and processes that could be fruitful to positively influence the MHW of their students [1].

Recent research comparing the MHW situation of engineering students with students from other majors has revealed that undergraduate engineering students perceive their MHW to be inferior to their counterparts in other majors [23]. Also, engineering students are less likely to seek professional psychological help compared to students in other majors [24]. This calls for immediate attention to the MHW of undergraduate engineering students.

Mental health research may use phrases like mental illness and mental problems to indicate adverse mental health, or mental wellness and mental wellbeing to refer to prosperous mental health. Therefore, for consistency purposes, throughout this paper, we use Mental Health and Wellbeing (MHW) as a balancing phrase as suggested by Asghar and Minichiello [22].

2. PURPOSE

There is evidence of academic [18, 25], psychological [14, 26], and physiological [13, 27] interventions in undergraduate engineering settings to support MHW and students, but we could not find evidence of a dedicated MHW course. Therefore, to support MHW and ultimately the success of undergraduate engineering students, this study aims to introduce a first-year happiness and wellbeing course by offering its learning goals and objectives. Specifically, the authors wish to exemplify and discuss the research process that informed the formation of the proposed course goals/objectives for such a course. Our focus is on a first-year course because of three reasons i.e., 1) MHW and lifelong learning skills integration in first-year engineering courses have been advised by researchers for student success [28], 2) such interventions are desired by engineering

undergraduates, and 3) MHW and personal learning reflections have been received positively by both engineering undergraduates and their faculty [29].

3. CONCEPTUAL UNDERPINNINGS

Our proposed first-year engineering happiness and wellbeing course finds its foundations in three literary works. The backward design model [30] approach provides an overall framework of how this course is structured and functions. The seven factors analytical framework conceptualized by the authors in our previous work [31, 33] helps develop goals for the course. The objectives corresponding to these goals are guided by the Krathwohl's taxonomy of affective domains [34].

3.1 Backward Design Model

We ground the overall design of this course in the Backwards Design Model presented by Wiggins and McTighe (2005) [30]. On one hand, the traditional curriculum design approaches are purposefully activity-oriented where the activities are sought out and designed without careful consideration of what goals these activities might achieve. Course content is produced and activities are formed to serve the content [35]. On the contrary, the purpose of backward designs is to focus on the goals of a course curriculum and then design content and subsequent activities that would ultimately serve the set goals [30]. It supports the development of well-sought and thought-out goals as the first step to course curriculum development followed by an assessment plan and learning plan. Backward design is like a “road map” to a set destination.

3.2 The Seven Factors Analytical Framework

Complementing the backward design model by Wiggins and McTighe (2005) [30], we develop our goals as a first step for our proposed first-year undergraduate happiness and wellbeing course. The Seven Factors Analytical Framework conceptualized by us in a previous study [31] and seen in Figure 1 helped us develop six goals for our course. The framework was conceptualized based on an exploratory study involving undergraduate engineering students' interviews. The study is explained in the methods section below.

The seven factors (learning experiences, financial support, task organization, support environment, engineering practice opportunities, and task orientation) in the analytical framework contributed to the subjective wellbeing (SWB) of undergraduate engineering students in four domains i.e., academic satisfaction, school connectedness, academic efficacy, and college gratitude. SWB is “a person's self-perceptions of “positive” inner events, which are defined as personally or socially desirable patterns of thinking (cognition) and feeling (emotion) [36]. In simple words, it is a scientific word to refer to happiness and life satisfaction [37].

Our exploratory study [31], helped us identify the seven factors contributing to undergraduate engineering students' happiness and wellbeing. Students were of the view that multiple institutional, social, and personal factors contributed to their SWB. For example, institutional factors like quality learning experiences offered by their institute, availability of financial resources through their college, the existence of an overall support environment, and engineering

practice opportunities at their institute helped towards their happiness and life satisfaction. In addition, social factors like financial help from home and personal factors like the ability to efficiently organize academic tasks and a unique ability to be oriented towards academic goals objectively were also contributing towards the attainment of their SWB.

Figure 1 details the path the seven factors follow through the four domains to achieve SWB in undergraduate engineering students.

Figure 1

The Seven Factors Analytical Framework [31]



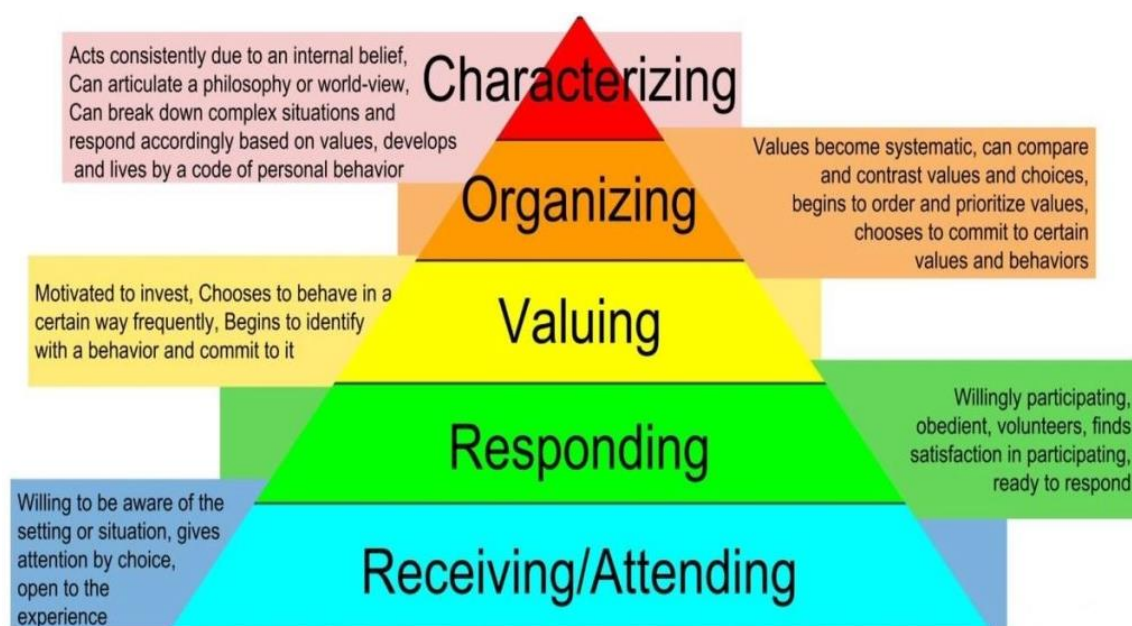
Objectives that lead towards the set happiness and wellbeing course goals are grounded in the Krathwohl's Taxonomy of Affective explained in the following.

3.3 Krathwohl's Taxonomy of Affective Domains

Krathwohl's Taxonomy of Affective Domains focuses on the learner's emotions and feelings that are manifested in their attitudes, interests, and values [40]. This taxonomy is a unique way of establishing educational objectives and classifying educational goals [34]. In the interest of our first-year engineering course, the taxonomy helps us set course objectives that can effectively reach out to the mental and emotional faculties and engage students to achieve the set happiness and wellbeing goals. As shown in Figure 2, the taxonomy functions as a hierarchical structure in which simpler feelings, emotions, and attitudes lead to more complex and engaged ones.

Figure 2

Krathwohl's Taxonomy of Affective Domains [40]



At the receiving level, the educators attempt to simply create a sense of willingness in students through class activities. The objectives developed to achieve receiving by students would usually be characterized by keywords/verbs like chooses, shows willingness, etc. At the responding level, course objectives use keywords/verbs like answer, responds, etc. to refer to active participation in the class. Valuing by students is not simple attention or response by the learners but checks for student commitment. Objectives to correspond to valuing use keywords/verbs like demonstrates describes etc. Organizing is about the construction of an internally consistent value system in students where students can reason and relate different concepts. Keywords/verbs like generalize, arrange, etc. are used in objective development to flourish the quality of the organization. The last level of the taxonomy is characterization. The learners at this level have a value system and are expectedly in control of their behavior. The objective for learning outcomes at this level may consist of keywords/verbs e.g., proposes, verifies, etc.

4. METHODS

Two studies support the development of the goals and objectives of our proposed first-year engineering happiness and wellbeing course. Study 1 guides our goals while Study 2 guides the objective that helps achieve these goals.

4.1 Study 1

Some details of study 1 [31] were provided in section 3.2: The Seven Factors Analytical Framework. This was an exploratory study involving eight undergraduate engineering students (3 females, 5 males) purposefully selected. Emails, with a link to a Qualtrics screening survey, were sent to all of the engineering college faculty with the request to post the link on the undergraduate engineering course they were teaching. Participants were then purposefully selected based on their responses to the screening survey. Data from these interviews were transcribed, identified, and analyzed. As suggested by Creswell and Poth [38], and guided by Saldaña [39], a thematic analysis of the interview data was conducted based on consensus between two coders. The thematic analysis helped identify patterns in the interview data relating to the important factors perceived by undergraduate engineering students to be important to their MHW. The resultant eleven themes were then re-grouped and conceptualized into seven factors as can be seen in Figure 1. Please read our published work about this study [32] for further details.

Table 1

Open-ended survey questions developed from the study data

Factor(s)/Construct(s)	Open-Ended Question
Faculty support/All constructs	In what ways does the college of engineering faculty contribute to your wellbeing?
Learning experiences/Academic satisfaction and school connectedness	How do the learning experiences provided within the college of engineering contribute to your academic satisfaction and/or feelings of connectedness within the college?
Financial support/Academic efficacy	How does financial support from different sources enable you to complete your assigned academic tasks successfully?
Task organization/Academic efficacy	How do task organization strategies enable you to complete your assigned academic tasks successfully?
Support environment/School connectedness	How does the support provided within the college of engineering contribute to your feelings of connectedness within the college?
Engineering practice organization and task orientation/College gratitude	How does an environment focused on engineering practice contribute to your feelings of gratitude toward the college of engineering?
General	Can you please describe any other factors that contribute to your wellbeing within the college of engineering?

Seven open-ended questions (Table 1) were developed to further investigate the seven factors in details. These seven open-ended questions guided our Study 2.

4.2 Study 2

Study 2 was part of a larger mixed methods study following Study 1. Students in the college of engineering were invited to answer a mixed methods study that included both quantitative and qualitative parts. The qualitative part of the study, which involved answering the seven open-ended questions (Table 1) developed based on study 1 [31] is of interest here and referred to as study 2. After approval from the IRB, a convenience sampling strategy was used to recruit study participants. Emails, with a link to a Qualtrics survey with open-ended questions, were sent to all of the engineering college faculty with the request to post the link on the undergraduate engineering course they were teaching. The survey link was also included in the weekly college of engineering newsletter for consecutive two weeks. A total of 105 (1 gender non-conforming, 22 females, and 82 males) engineering undergraduates responded to the open-ended questions. Open-ended data was analyzed through thematic analysis as suggested by Creswell and Poth [38] and guided by Saldaña [39]. The thematic analysis helped identify patterns in the qualitative data from the open-ended questions that further explained the mechanism of the seven factors through which they contributed to the MHW of the participating engineering undergraduate students. Two researchers were involved in the coding process. Data were coded, categorized, and themed. The qualitative coding process was consensus-based between the two researchers involved in the thematic analysis. The resultant themes guided the development of our goal objectives.

5. COURSE DEVELOPMENT

5.1 Course Goals

As shown in Table 2, the seven-factor analytical framework (see Figure 1) resulting from our exploratory study [31] guided the setting up of the six learning goals for the proposed happiness and wellbeing course. The goals correspond to the themes emerging from the thematic data analysis of the qualitative data from undergraduate engineering student interviews.

Table 2

Identified factors [31] and their corresponding learning goals

Identified Factors	Corresponding Goals
Faculty Support	Foster faculty-student relations beyond the typical.
Financial Support/ Engineering Practice Opportunities	Support students' efforts to access available financial resources.
Learning Experiences	Flourish independent and interdependent learning skills in students.

Task Organization/ Task Orientation	Guide students to efficiently manage their assigned academic tasks.
Support Environment	Enable students to be healthy and contribute to an overall positive college environment.
Support Environment/ Engineering Practice Opportunities	Support student needs by equipping them with information retrieval skills.

These course goals will be achieved by achieving their corresponding objectives resulting from the thematic data analysis of the qualitative data gathered through open-ended questions from undergraduate engineering students in study 2. As explained earlier, the open-ended questions were developed corresponding to the seven-factor analytical framework (see Figure 1).

5.2 Learning Objectives and Their Expected Outcomes

In the following, we state the objectives corresponding to each goal and explain how these objectives help achieve these goals. Keywords/verbs (*italicized*) as suggested by the Krathwohl's Taxonomy of Affective Domains [34, 40] guide our objectives/outcomes to demonstrate they can enact an affective learning behavior.

Goal 1: Foster faculty-student relations beyond the typical.

Objective 1: *Explain* to students why an effective relationship with their faculty members is important for their personal, academic, and professional growth.

Outcomes: Students are able to *identify* the need to interact more effectively with their faculty and *revise* engagement with them.

Objective 2: Encourage students to reach out to their faculty during classes and in office hours to *discuss* any persistent issues seek guidance, and *identify* solutions.

Outcomes: Students are able to *initiate* interaction with their faculty and engage more with them in class. Students will be able to join their faculty during their office hours to be able to *solve* problems in hand based on their guidance.

Goal 2: Flourish independent and interdependent learning skills in students.

Objective 1: Facilitate students to work on their own and be able to *adhere* to an open mind to work in diverse teams.

Outcomes: Students can solve problems on their own and are able to appreciate working in teams and *solve* problems.

Goal 3: Support students' efforts to access available financial resources.

Objective 1: Assist students to *identify* internal and external financial resources and assistance.

Outcomes: Students can *identify* internal and external financial resources including paid teaching assistantships, scholarships, paid internships, paid undergraduate research opportunities, etc.

Objective 2: Motivate and *prepare* students to apply for available financial resources and assistance.

Outcomes: Students *display* a willingness to apply to their identified financial resources and assistance.

Goal 4: Guide students to efficiently manage their assigned academic tasks.

Objective 2: Inform students about different task management strategies they can use to enhance their learning.

Outcomes: Students can *identify* task prioritization, scheduling, and time management strategies for better task performance.

Goal 5: Enable students to be healthy and contribute to an overall positive college environment.

Objective 1: Flourish a sense of community in students by *describing* the need for an overall positive college environment.

Outcomes: Students *value* and appreciate being a part of an engineering community and willing to participate in collegiate events.

Objective 2: Assure and reassure students that resources are available to *help* them live a healthy life, both physically and mentally, characterized by academic success.

Outcomes: Students *join* student clubs. Students are able to *identify* and *locate* different education institutional facilities e.g. tutoring centers, physical fitness centers, and mental and physical health and wellbeing facilities.

Goal 6: Support student needs by equipping them with information retrieval skills.

Objective 1: Help students to learn to retrieve and manage information to prepare them to deal effectively with their mental health and wellbeing issues.

Outcomes: Students are *aware* of online search strategies to *perform* information searches to serve academic, professional, and personal needs. Students can ask to acquire information by emailing college and university faculty and staff members.

Objective 2: Students are guided to find engineering practice opportunities e.g., internships, and undergraduate research opportunities for themselves. Students can ask to acquire information by emailing college and university faculty and staff members.

The above goals and objectives/outcomes, when implemented through a first-year engineering course may have the capacity to improve the MHW of students by equipping them with the skills and strategies to thrive and flourish through their undergraduate engineering course and succeed. More related research and practice over time will suggest further refinements in the course for better outcomes.

6. LIMITATIONS AND FUTURE RESEARCH

The intention behind proposing this course is to manage the experiences of engineering first-year students in such a way that they feel welcomed in the college of engineering and become aware that a system is in place to support their mental health and academic progression. This course must not be mistaken to be intended as a cure for mental health issues that might persist among undergraduate engineering students. If such students are identified, the faculty delivering this course must guide them towards proper psychological support systems put in place at their respective institutions and must not attempt to act as psychological counselors.

The research leading to proposing this course was conducted at a white majority institution with more than 90% of the study participants being whites. We recognize that this course, if to be implemented on a full scale in first-year engineering, will need to undergo through further rigorous future research and refinement. Future research should consider ensuring the inclusion of more diverse study participants with an increased emphasis on the inclusion of minoritized groups to make the course more inclusive.

7. DISCUSSION AND CONCLUSIONS

The proposed course identifies ways in which students can establish and enhance effective relationships with their faculty. Research suggests faculty to be the first line of defense against students' mental health issues [41]. This course also attempts to improve learning experiences, which can contribute positively to their MHW [42]. This course supports teaching students task management strategies. Effective task management ensures self-control and better coping with mental health problems [43]. Students can be equipped with this course to search for information important to their academic success and MHW. For example, students will be able to search for available financial resources and assistance which are positively correlated to their academic performance [44].

The undergraduate engineering happiness and wellbeing course discussed in this paper focuses on building student capacity in many important areas. The goals and objectives which we aim to achieve with this course are widely supported by empirical research. We argue that this course will provide a solid foundation to undergraduate students when they need it the most, during their first year to thrive in the rest of their academic years.

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