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Global Engineering and Language Attitudes in the U.S.: A Quandary

Jorge Porcel
Missouri University of Science and Technology, porcelj@mst.edu

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A Quandary

Globalization and the international projection of engineering

In the last 30 years, the literature on engineering education has been paying increasing attention to the changes that the field has experienced due to the advancement of globalization. The goal of this concerted effort is to determine and validate the set of skills the job market demands from the engineer in the 21st century.

There is consensus among researchers that in the context of globalization the U.S. engineering programs either adapt their curricula to meet the expectations of the global workforce or take the risk of becoming irrelevant [1]. *Irrelevance* refers to the current curriculum overloaded with physics, mathematics, and science. In support of this position, the U.S. Department of Education [2] has made explicit to educators that graduates with the strongest scientific expertise in their field may find themselves at the margins of a global workforce in dire need of international, multicultural, and multilingual competencies.

How has globalization impacted the engineering profession? And why the current curriculum has become outdated? The first question can be answered with an example: the challenge that distance in space used to represent to human interactions has *virtually* disappeared. Today, meeting clients or managing projects at distant locations no longer requires physical displacement, and if physical displacement is required it takes only a fraction of the time and the money that it used to take. This example also answers the second question, since mobility has transformed the workplace, the job market and the type of proficiencies that new graduates need to bring to the labor market in order to remain competitive. According to Huntley [3] a key feature of the global engineer's employability will be global mobility, i.e., the flexibility to comfortably move across a range of national and international niches and still performs at the highest level [3]. In Huntley's own words,

> [a]n engineer is now working in a borderless world, infused with collaborative technologies that have created the 24/7 office, working 7 days a week, 24 hours a day.

> Companies are using skilled engineering teams dispersed around the world to develop products in a collaborative manner, rapidly migrating from local cross-functional collaboration to a mode of global collaboration [3].

Huntley's review of literature [3] presents the arguments and the strong agreement among scholars that most of the programs in the U.S. are not adequately preparing the future engineer to succeed in the 21st century workplace described in the previous quote.

To address the previous concern, two interconnected efforts appear in the literature. One is to define the profile of the global engineer; the second, elaborate a set of skills and competencies the global engineer needs to meet the demands of the 21st century globalized job market. Citing from one study that compared the practices and the professional cultures of American and Japanese engineers:

> A 'global engineer' [...] [is one that has] the personal qualities, international knowledge, and technical skills required to work effectively in a range of international settings and work environments [4]

As for the set of competencies the study lists:

> (1) language and cultural skills, (2) teamwork and group dynamics skills, (3) knowledge of the business and engineering cultures of counterpart countries, and (4) knowledge of international variations in engineering education practice [4]

More recently, the Canada chapter of *Engineers Without Borders* conducted an international survey that included faculties, engineering students, and industrial leaders in an effort to define the key attributes that best characterize the global engineer and its competencies. A sample of the list provided by Chan and Fishbein [5] contains the following:

> • superior communication skills and understanding across different cultures and languages;
> • a facility for multidisciplinary and interdisciplinary teamwork;
> • a well-developed sense of social responsibility and ethics, with due consideration in his/her personal and professional activities;
> • being entrepreneurial; and

• an ability to deal with complexity and systems thinking.

As it stands out, communication skills, international knowledge, multilingualism and multiculturalism figure prominently in both quotations. These same competencies emerge almost invariably in Huntley's extensive review of literature signaling their importance. At the level of the federal government, the same priorities are articulated by the U.S. Departments of Education [2] and Defense [6]. However, these reports also convey a sense of urgency, insisting on the need of building up the depleted capacity in second languages (L_2) –i.e., languages other than English– and revamping the international curriculum for the whole education system. In total agreement, both reports [2] [6] assert that, at the bare minimum, college graduates need to enter the 21st century job market with proficiency in at least one L_2 as well as multicultural competence, i.e., awareness and appreciation for other cultures.

Before finishing this section, it seems pertinent to address a possible confusion: multilingualism and multicultural competence is not only important at the international level. The age of globalization is also the age of massive international migration, what has brought to the forefront the challenge of multilingualism and multiculturalism within national borders. A recent survey shows that the *Class of 2025 [is] expected to be the biggest, most diverse ever* [7]. That means that within 5 to 10 years these graduates will be bringing more diversity to the U.S. labor force. In addition, the U.S. Census Bureau estimates that by 2044 more than half of all Americans will belong to a minority group [8]. Finally, Colby and Ortman [9] assert that by 2060 nearly one-in-five of the U.S. population is projected to be foreign-born. Therefore, as the reports from the Department of Education [2] and Defense [6] assert, at the bare minimum, college graduates need to enter the 21st century job market with proficiency in at least one L_2 and multicultural competence –i.e., awareness and appreciation for other cultures.

In conclusion, the literature considered in this introductory section makes it clear that the effects of globalization are far reaching, going beyond curricular issues in the field of engineering. The world is changing and nations are changing along with it. Daily news, statistics, and everyday life experiences, all indicate that human contacts in the 21st will be marked by increasing linguistic and cultural diversity due to the higher frequency of international contacts and demographic diversity within the national borders. Not only the

workplace will become more diverse but also schools, neighborhoods, churches, and every social institution.

The U.S. deficit in languages other than English

Previously it has been argued that "superior communication skills and understanding across different cultures and languages" [5] are required to be competitive in the 21st century job market. Such a statement conflicts with the assessment from the U.S. Departments of Education [2] and Defense [6] which makes it clear that the nation's capacity in second languages (L_2 – languages other than English) is insufficient. Therefore, the U.S. faces a major obstacle to global graduate engineers.

The issue can be analyzed from two different –although interconnected– perspectives. At the descriptive level, the lack of competence in L_2 is a matter of numbers. At a deeper or more explanatory level, the same issue is a matter of attitudes understood as unawareness of the importance of such competence by the majority of the population.

Starting at the descriptive level, in the last 40 years a variety of surveys have measured the competency in L_2 in the U.S. population and the results have been consistent. In 1979, a survey commissioned by the *President's Commission on Foreign Language and International Studies* found that only 24.2% of all U.S. adults had competence in L_2 [10]. Assessing the situation, the Commission's report declared that "Americans' incompetence in foreign languages is nothing short of scandalous…" [11]. Twenty years later, a nationwide representative Gallup poll reported 26% of bilingualism [12]; and after twelve more years, another national Gallup poll found 34% [13] –see this note for an explanation on the 8% increase from the previous poll]. In 2017, the study *America's Languages. Investing in Language Education for the 21st Century* reported that "[o]nly 20.7 percent of American adults can speak a foreign language —compared with 66 percent of all European adults who know more than one language" [14]. Finally, in 2018, an MLA preliminary survey on enrollments in L_2 found a 9.2% decline in U.S. colleges and universities between 2013 and 2016 [15]. In summary, if competence in L_2 is a crucial skill for the 21st century workforce, one must wonder how many college graduates will succeed in the globalized job market.

This section has presented descriptive evidence of the shortage of L_2 skills in the U.S.

population. The next one will elaborate on the topic of language attitudes.

Attitudes toward L_2 in the U.S.

One key predictor of L_2 acquisition, maintenance of bilingualism, and attainment of L_2 proficiency is the attitudinal variable. The Gallup polls [12] [13] included some attitudinal questions. One of them assesses the importance of bilingualism: *How important is that Americans learn to speak a second language other than English?* Table 1 shows the frequency for each category of response.

Table 1: Frequency of response to the question *How important is that Americans learn to speak a second language other than English?* in McComb [12] and Jones [13] *

	Essential	Important but not essential	Not too important	Not at all important	No opinion
McComb (2001)	19%	50%	17%	11%	1%
Jones (2013)	20%	50%	18%	12%	N/A
Increment	+1%	0	+1%	+1%	

* Totals may not equate to 100% due to rounding.

As table 1 illustrates, only around 20% of all Americans believe it is *essential* to learn a L_2 whereas around 30% considers it *of little* or *no importance*.

Eddy's survey [10] included a different question: *Learning a Foreign Language helps a person get a good job in this country?* Only 7.5% strongly agreed, whereas 50% disagreed or strongly disagreed. These numbers are important because they confirm that the general population does not perceive an instrumental or practical need to acquire an L_2. These quantitative perceptions from 1980, were qualitatively confirmed in 2017 by the words of the Pentagon's director of Defense Language and National Security Education: "Right now, the inability to speak a foreign language doesn't prevent someone from being accepted into or rising through the ranks of the U.S. Foreign Service or the military" [14]. If L_2 proficiency is not required for promotion where it is critically needed –the U.S. Foreign Service and the military– it is understandable that the perception of lack of importance is widespread in the U.S. what in turn explains the shortage in such qualification among the general population.

Interestingly, there is some ideological pressure to comply with the idea that the knowledge of an L_2 is somewhat valuable or, more plausible, that *denying* the value of L_2

competence reflects negatively on the respondent. That explains why 50% of Eddy's [10] sample *disagreed* or *strongly disagreed* with the need of an L_2 to get a better job in the U.S., whereas at the same time 45% from the same sample, answered they would like to learn an L_2 in the future. It is hard to believe that the 45% that support the latter claim is expressing the real determination or goal of learning an L_2 in the near future. They are just conveying a *social desirability bias* created by the topic of the questionnaire. The same bias affects the rate of response in table 1 under the category of *Important but not essential* in McComb [12] and Jones [13]. In effect, if from 45% to 50% of the U.S. population had seriously considered mastering an L_2, the proportion of bilingualism would have had to increase in the span of these 40 years.

The data in table 2 presents the answers to a different attitudinal question. This question addresses the issue of how the monolingualism of immigrants conflicts with the monolingual American: *How important is that immigrants living in the United States learn to speak English?* in McComb [12] and Jones [13].

Table 2: Frequency of response to the question *How important is that immigrants living in the United States learn to speak English?* in McComb [12] and Jones [13] *

	Essential	Important but not essential	Not too important	Not at all important	No opinion
McComb (2001)	77%	19%	2%	1%	1%
Jones (2013)	72%	24%	2%	1%	N/A
Increment	-5%	+5%	0%	0%	

* Totals may not equate to 100% due to rounding.

The figures in tables 1 and 2 under the category *Essential* present a dramatic contrast. In table 1, twenty percent of Americans considered *essential* to become bilinguals. In table 2, a large majority of Americans (77% and 72%) consider English bilingualism *essential* for immigrants. In other words, the contrast shows a double standard: Americans support monolingualism for themselves but bilingualism for those who do not speak English. Of course, linguistic nationalism is most likely the frame of interpretation for those responding that it is *Essential* for migrants to know English in the U.S. For them, the answer is ideological and probably nothing else has been taken into consideration.

Tables 3 and 4 present the contingency tables for the previous questions, i.e., *How*

important is that Americans learn to speak a second language other than English? and *How important is that immigrants living in the United States learn to speak English?* by race/ethnicity, political party affiliation, and political ideology. Unfortunately, this data is not reported by McComb [12].

Table 3: Frequency of answers to the question *How important is that Americans learn to speak a second language other than English?* by race/ethnicity, political party affiliation, and political ideology in Jones [13] *

	Essential	Important	Not important
Whites	17%	50%	32%
Blacks	27%	49%	23%
Hispanics	30%	51%	18%
Democrats	24%	53%	23%
Independents	21%	51%	28%
Republicans	13	46%	40%
Liberals	23%	55%	21%
Moderates	23%	53%	24%
Conservatives	16%	45%	38%

* Totals may not equate 100% due to rounding

Table 4: Frequency of answer to *How important is it that immigrants living in the United States learn to Speak English?* by race/ethnicity, political party affiliation, and political ideology in Jones [13] *

	Essential (%)	Important (%)	Not important (%)
Whites	77%	20%	3%
Blacks	67%	26%	5%
Hispanics	58%	38%	2%
Democrats	65%	30%	4%
Independents	71%	25%	3%
Republicans	85%	14%	2%**
Liberals	59%	37%	4%
Moderates	74%	23%	2%
Conservatives	80%	16%	3%

* Totals may not equate 100% due to rounding.
** Percentage goes over 100 in Jones [13]

The cross-tabulation of responses by race/ethnicity, party affiliation, and political ideology offers an illuminating picture of the social and political beliefs underlying the

language attitudes under discussion. On the one hand, table 3 indicates that the cluster *Republican-Conservative-White* has the largest number of supporters of English monolingualism –i.e., knowledge of an L_2 is not important. Contrarily, the intersection *Hispanic-Liberal-Democrat* shows the lowest support for the latter proposition. Table 4, on the other hand, shows how the cluster *Conservative-Republican-White* represents the largest number of supporters of bilingualism when the language to be added is English –i.e., they consider that knowledge of English in the U.S. is essential. At the opposite end, the intersection *Liberal-Hispanic-Democrat* displays the lowest support for that position.

Some data presented by McComb [12] –and unfortunately, not by Jones [13]– adds support to the previous findings. Political ideology seems to be a factor on becoming bilingual: *Liberals* claim the highest number of bilingualism at 33%. A ten-percent gap places *Conservatives* at the lowest end at 23%. Closer to *Conservatives* than to *Liberals*, *Moderates* claim 26% [12]. These findings make sense, since *Liberals* are more likely to voice support for multiculturalism and multilingualism than *Conservatives*.

In sum, the study of language attitudes opens a window into how Americans perceive the importance of learning an L_2. In general, they frame it in terms of linguistic nationalism so they support English monolingualism although they support bilingualism when the language to be added is English. The previous analysis just puts in evidence how misguided such a misconception is in a globalized world.

Language Attitudes

In general, the last section argued there is a relationship between mastering an L_2 and language attitudes in the U.S. It also revealed that the commitment or resistance to learning an L_2 could be an act of identity, traceable to ethnicity, political beliefs, and party affiliation. For similar reasons, Gardner made the claim that L_2 learning is rooted in the field of social psychology [16] where the notion of attitude is a core concept [17].

Briefly defined, language attitudes are learned dispositions to react positively or negatively to linguistic objects. *Linguistic objects* refer to languages, like English and Spanish, or particular features of language systems [18]. Attitudes consist of three components: cognitive, affective, and behavioral. The *cognitive component* is embedded in the belief

system, i.e., worldviews and ideologies. As the previous discussion showed, political beliefs related to ethnicity result in different attitudes towards English monolingualism or bilingualism in L_2. The *emotional* or *affective component* can be inferred from the link between language and ethnicity. Since language is a key component of individuals' identities, positive or negative reactions towards one's language will certainly trigger emotional reactions from individuals. Finally, attitudes have a *behavioral component* that predisposes peoples to act in alignment with their beliefs and emotions. This is apparent in the connection between political ideology and competence in L_2. As discussed at the end of the previous section, there is a 10% gap between Liberals and Conservatives in terms of bilingual competence. This fact can be explained in terms of three components that underlie an attitude: *cognitively,* Liberals favor the idea of a more egalitarian and culturally open society; arguably, such beliefs are supported by a set of values like social justice, solidarity, empathy, etc., which trigger *emotional responses*; finally, those beliefs and emotions influence Liberals' *behaviors* in the sense that they are more inclined to learn an L_2, as the 10% gap with Conservatives indicates.

However, the alignment between the three components is not always as straightforward as in the previous case. The explanation provided by Ajzen and Fishbein [19] and Ajzen [20] hypothesizes strategic mediations between cognition and emotion, usually in agreement, versus actions, not always aligned to the previous: I.e., individuals ponder the costs and benefits of acting according to their beliefs and emotions vis-à-vis the situational goals they wish to attain. Furthermore, they take into consideration how their actions will be perceived by others. In contemporary societies, and especially in certain institutional settings, there are reasons to display social compliance and acquiescence for fear of being perceived as a racist, intolerant, insensitive, radical, etc. Thus, pressures towards acquiescence might affect not only people's behaviors at a workplace meeting but also when they answer questionnaires, like the one used in this study. Eliciting attitudes on topics as sensitive as minority languages, ethnicity, diversity, inclusion, etc. in a higher education setting needs to contemplate the possibility of a certain amount of compliance and acquiescence in the data.

Orientations in L_2 acquisition

Since the 1950s, the work on language attitudes has identified two orientations towards L_2 learning [16]. The *instrumental orientation* defines a utilitarian interest in the learning of

the L_2, such as getting better jobs, higher salaries, social status, so the language is only a means to social gains with very little interest in the culture or the community of people who speak the language. On the contrary, the *integrative orientation* implies a personal involvement or desire to connect with the community that speaks the language, get access to its culture or even become a member of the group. The former distinction is not supposed to be taken as a mutually exclusive dichotomy since there is an element of instrumentality in the integrative orientation [21] [22].

The remaining sections of this paper will present a study on language attitudes among undergraduate students enrolled in an engineering public university. Before moving on to the next section, a brief synthesis of the discussion up to this point will be offered: (1) with the thrust of globalization, multilingual and multicultural capabilities have become crucial to be competitive in the 21st century workforce; (2) these competencies have special weight for engineers as engineering becomes a global profession, to the point that the old curriculum must be changed in order to include them; (3) in addition, the international projection of engineering and the demographic changes that affect the workplace presuppose familiarity with such competencies in order to interact effectively with clients and coworkers; (4) the FL capacity of the U.S. population is virtually nonexistent not only compared to European countries but also to other countries that are trying to become economically and politically more influential –a clear example is China's current steps toward building a multilingual workforce [23]; (5) at the heart of building that capacity is the variable of language attitudes, a key motivational factor for mastering L_2; (6) most Americans have negative attitudes toward learning an L_2 since they consider it an unimportant skill, one that will not help them to get jobs nor will help them to get promotions.

Language attitudes at UNV: A preliminary study

The objective of this study is to understand to what extent language attitudes are a factor underlying the low enrollment in Spanish courses at UNV [24]. Using the mean of the total undergraduate enrollment over seven academic years, the matriculation in all L_2 courses taught at UNV represents 5% of that total over said period [25]. Of this 5%, 1.7% corresponds to Spanish and the remaining figure is distributed among the other three L_2 offered at UNV. If engineering is increasingly becoming a global field, and if FLs are key to the education of

global engineers, then it seems reasonable to conclude that a majority of UNV's undergraduates are lacking an important skill in order to be competitive in the 21st century job market.

The initial hypothesis is that *one* significant reason is rooted in the language attitudes of the U.S. population toward L_2 in general and Spanish in particular, due to its natural association with the Hispanic community. Therefore, the research question that will guide this inquiry is the following: *Do language attitudes represent a factor in the low enrollments in Spanish and other FL courses at UNV?* In addition to that question, this pilot research has two objectives: (1) to obtain preliminary insights from the data, and (2) use these insights to improve the initial questionnaire created for this study.

Methodology

Instrument

To design the questionnaire, four dimensions (or constructs) were chosen as basic building blocks:

(1) attitudes toward *learning Spanish and other* L_2;
(2) *instrumental orientation* toward Spanish and other L_2;
(3) *integrative orientation* toward U.S. Hispanics and Latin American countries;
(4) attitudes toward *global experiences*, at the international level –like studying abroad– and within the U.S.

These four dimensions were populated with a total of twenty-four Likert-type items with five categories of response. In addition, the questionnaire contained thirteen items to account for demographic variables and L_2 enrollment before college. The instrument was formatted using a Qualtrix's template and distributed via email. Responses were collected for about 2 months, from early April to early June of 2018. After the initial request, no reminders were sent asking potential participants to complete the questionnaire. Therefore, it is reasonable to conclude that respondents were interested in the topic as described in the email's subject: *Survey on Foreign Languages at UNV*. According to the Qualtrix's distribution report, the audience size was 6340, 489 surveys were started, 447 responses were submitted, and the number of cases that will be used in this paper is 436. Table 5 presents the basic outline of the instrument.

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Sampling

The sampling methodology was a convenience sample of UNV undergraduates who voluntarily completed and submitted their responses.

Characteristics of the sample

Respondents were UNV undergraduates enrolled in the Spring semester of 2018. UNV is located in the Midwest, the area with the highest concentration of English monolinguals in the U.S. [12] [13]. Most of the students are from the state where UNV is located or neighboring Midwestern states. Only 1.6% were part-time students (n = 7). The sample consisted of 241 males (55.5%) and 181 females (41.5%). Women are overrepresented in the sample since they almost double the actual female enrollment, based on a seven-year average. Ninety-two percent of participants were between 18 and 23 years old. Ethnic diversity was insignificant since the vast majority were white (n = 375 or 86%), followed by Hispanic/Latino (n = 27 or 6%). The remaining 8% were made up of 6 different ethnic groups. The vast majority (n = 374) claimed one major, 348 (93%) in a STEM field and 26 (7%) in humanities or social sciences. As for L_2, a large majority (n = 405, 93%) had taken foreign language courses before college and only 30 respondents (7%) had not done so.

Analysis

Principal Component Analysis (PCA), one of the methods of factor analysis, was selected to analyze the data, using SPSS version 24. The selection of PCA was based on the goals to be attained: (1) to look for emerging patterns from the data with minimal theoretical bias [26]; (2) to reduce the number of variables; (3) to assess the validity of the initial dimensions used to develop the instrument.

Since PCA's final result is to reveal groupings of individual variables highly correlated within their component but uncorrelated with the variables in other components, it is possible to test two hypotheses about the questionnaire: (1) there will be a perfect correspondence –i.e., a one-to-one– between the number of initial dimensions and the number of components in the output of PCA; (2) there will be a perfect correspondence between all of the variables included

in the initial dimensions and all of the variables included in the output of PCA.

Most statistics' tests are based on a number of assumptions that the data should conform to in order to be applicable. For PCA, Kaiser-Meyer-Olkin measure of sample adequacy (KMO) and Bartlett's test of sphericity, are both preliminary tests the data should pass. The overall KMO score was 0.874 which is considered very good as well as the individual KMO measures which ranged from excellent to good –i.e., from 0.930 to 0.812 [27]. Bartlett's test of sphericity was significant ($p < 0.0001$). Therefore, the data was adequate for PCA.

As stated above, one of the goals for using PCA was to reduce the number of variables. To that end, the correlation matrix (see table 6) was inspected to exclude any variable with correlation coefficients lower than ±0.3. Other variables were eliminated at a later stage because they either constituted a trivial component or their loadings were trivial (see below). After these corrections, the number of variables went down from twenty-four to seventeen. Also, the number of participants was reduced by 10 do to missing values, so instead of the initial 436, the number of cases subjected to PCA was 426.

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Based, on 17 variables, PCA revealed three components with eigenvalues above one. The amount of cumulative variance explained by these three components amounted to 61.633%, and individually, each component –first, second and third– explained a total variance of 33.585%, 20.901%, and 7.148%, respectively (see table 7). Visual examination of the scree plot was consistent with a three-component solution as well.

Table 7: Total variance explained for the study of language attitudes among UNV undergraduate students

	Initial Eigenvalues		
Component	Total	% of Variance	Cumulative %
1	**5.709**	**33.585**	**33.585**
2	**3.553**	**20.901**	**54.485**
3	**1.215**	**7.148**	**61.633**
4	.841	4.948	66.581
5	.815	4.797	71.378
6	.712	4.187	75.565

7	.663	3.903	79.468
8	.563	3.312	82.780
9	.500	2.944	85.723
10	.484	2.846	88.569
11	.392	2.309	90.878
12	.373	2.194	93.072
13	.294	1.730	94.801
14	.260	1.532	96.333
15	.249	1.468	97.801
16	.192	1.127	98.928
17	.182	1.072	100.000

The method of rotation employed was Varimax as recommended by Kim and Mueller for the exploratory stages of analysis [28] [29]. As was said two paragraphs above, the rotated matrix was used to exclude trivial components and variables with trivial loadings [30] within the components. Finally, the three-component solution passed the test of interpretability, although without achieving a simple structure [31] (see table 8).

Table 8: Rotated Component Matrix[a] of the study of language attitudes among UNV undergraduate students, using Varimax rotation *

Questionnaire items	1	2	3	h^2
13. Learning Spanish is/could be a pleasant experience for me	.833			.274
4. I am interested in learning Spanish.	.826			.701
15. Learning Spanish is useful.	.814			.716
7. Being able to speak Spanish will help further my career	.770			.527
8. The fact that Spanish are the largest minority group in the U.S. makes it important to learn Spanish in the U.S.	.766			.610
18. I find it interesting to learn about Hispanics in the U.S.	.751			.620
17. I find it interesting to learn about Latin American countries.	.714			.661
19. I am interested in studying abroad in a country where Spanish is the main Spoken language.	.600		.562	.709
5. I am interested in learning a foreign language but not Spanish.		.832		.703
14. Learning a foreign language other than Spanish is/could be a pleasant experience for me.		.796		.685
10. I find learning foreign languages engaging but not Spanish.	-.401[b]	.670		.487
16. Learning a foreign language other than Spanish is more useful than Spanish.		.671		.548

6. I would like to have more space in my schedule for foreign language and culture classes.	.453[b]	.553		.612
2. I plan to graduate with a minor in a language other than Spanish.		.501		.696
22. I am interested in travelling outside the U.S.			.782	.724
20. I want to study abroad in a country where English is not the main spoken language.		.306[b]	.780	.660
23. I like getting to know people from other countries.			.637	.509
Percentage of variance explained by each factor	**33.585**	**20.901**	**7.148**	**61.633**

[a] Rotation converged in 5 iterations.
[b] Loadings below .450 are considered trivial
* Empty cells correspond to values that are less than ±0.3

Upon completing PCA, the next step was to assess the reliability for each of the three components. To that end, Cronbach's alpha measure of reliability was employed. The results are as follows: for the first component, alpha was 0.910, 0.783 for the second and 0.748 for the third. They were all reliable: the first component achieved an excellent coefficient of reliability; the coefficients for the other two components were just good, but not to the level of excellent.

Summarizing the accomplishments, PCA proved to be useful in the achievement of the following goals: first, the elimination of superfluous variables. From the methodological viewpoint, they were not efficient at measuring the construct that they should have measured. In consequence, they will have to be revised before their inclusion in the final questionnaire. Second, the hypothesis that predicted a perfect correspondence between the number of dimensions in the questionnaire and the number of components in the output of PCA had to be rejected, since the four initial dimensions were reduced to three components. Similarly, the hypothesis that predicted a one-to-one correspondence between the variables in the initial dimensions and those in the PCA components had to be rejected as well, since the variables in the first and second components have no relationship to their original organization. However, the variables in the third component all belonged to the original fourth dimension, labeled *global experiences*. These findings will be very insightful at the moment of rewriting the questionnaire.

The next section will look in more detail to the PCA's output and three-component solution. One of the most important confirmation that the PCA solution is appropriate relies on its interpretability.

Discussion

The four original dimensions in the questionnaire were: (1) Attitudes toward the learning of Spanish and L_2; (2) instrumental orientation; (3) integrative orientation and (4) attitudes toward *global experiences*. These dimensions were reorganized into three components. The variables in the first three dimensions were distributed into the first two components. The variables in the fourth dimension, though, moved to the third component.

The fact that dimensions (1), (2) and (3) were not discriminated by PCA seems to imply that, based on participants' experiences, constructs such as instrumental and integrative orientation are not relevant enough as to be discriminated in specific components. As McComb [13] and Jones [14] reported in their surveys, the Midwest is the U.S. region with the lowest concentration of bilinguals. Therefore, it seems reasonable to conclude that most participants do not have enough frequency of contact with bilinguals in order to discriminate between instrumental and integrative orientation. However, they do discriminate *global experiences* from the rest of the variables, exhibiting a level of awareness in this regard.

In order to find the logic that groups the variables in the first component, it is necessary to examine the content of the variables allotted to this component. What all of the variables have in common is a *positive attitude toward Spanish*, not only toward learning the language, but also toward its instrumental value, the U.S. Hispanic community and their countries or cultures of origin. Interestingly, it includes a variable that measures positive attitudes toward studying abroad in a Spanish speaking country. Logically, this variable is shared by two components: the first one, that represents positive attitudes toward Spanish and the third that represents global experiences. Following the common practice of designating the components with descriptive labels, it will be named *Positive Attitudes Toward Spanish* (PATS).

An analysis of the propositional content of the items included in the second component reveals that most of them are verbally loaded against Spanish. Based on this fact, it can be named *Negative Attitudes Toward Spanish*. For example, *I am interested in learning a foreign language but not Spanish* (item 5, r = 0.832) and *I find learning foreign languages engaging but not Spanish* (item 10, r = 0.796) clearly communicate negative attitudes against Spanish. However, it can be argued that not all of the items accept this interpretation. It can be claimed

that items 2 and 6 are neutral: *I plan to graduate with a minor in a language other than Spanish* (item 2, r = 0.501) and *I would like to have more space in my schedule for foreign language and culture classes* (item 6, r = 0.553), contradicting the interpretation given to this component. However, two quantitative measures support the interpretation that this component is organized around negative attitudes toward Spanish. The first is the value of Cronbach's alpha (0.786) which indicates a good internal reliability among the items in this component. The second is the items' loadings: the items heavily loaded against Spanish exhibit heavy loadings, whereas the items 2 and 6 present the lowest loadings.

Finally, as it was mentioned at the beginning of this section, the third and last component does have a correspondence with the fourth dimension and can be given the same label: *Attitudes Toward Global Experiences.* Contrary to the other three original dimensions, it is discriminated as a separate component by PCA. Its level of reliability is good so the variables form a coherent cluster measuring the same construct, but its overall importance is modest since it only explains around 7% of the overall variance, very close to 5% usually considered the cutoff point of relevance.

In summary, the three-component solution offered by PCA has discriminated two main components. Together they explain above 50% of the total variance. The first component consists of a cluster of highly correlated variables that capture positive attitudes towards Spanish. The second component is organized around negative attitudes toward Spanish, showing that they exist among the undergraduate population at UNV.

Concluding remarks

Before ending this paper, it is important to underline some concerns that have been only suggested or implied in the previous discussion. The first: there is ample consensus among scholars that "superior communication skills and understanding across different cultures and languages" [5] are required to be competitive in the 21st century job market, and that the engineering curriculum has to make space to include these abilities. However, the problem seems to be deeper than a curricular change: how are these multilingual and multicultural capacities going to be built in a nation where the level of L_2 competence is around the level of 25%, and where such skill is considered unimportant? Second, if nation-states in the 21st

century will be marked by increasing linguistic and cultural diversity, with Hispanics being a numerically important proportion of the U.S. total population, how will the coexistence be at the workplace and elsewhere between those who have negative attitudes toward Spanish and the U.S. Hispanics. The final question is the most intriguing: if a considerable number of UNV undergrads have positive attitudes toward Spanish and other L_2 what is the factor behind the low level enrolments in L_2 courses?

This study does not have answers for these questions because they will require qualitative data and a nationwide representative sample. However, before rewriting the questionnaire, the next logical research step should be the collection of qualitative data to address some of these final questions along with others that require qualitative data such as the relevance of the instrumental and integrative orientations in relation to UNV students.

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Table 5: Basic outline of the questionnaire used in the study of language attitudes among UNV undergraduate students

	Items / variables	Strongly agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Strongly disagree
1	I plan to graduate with a minor in Spanish.					
2	I plan to graduate with a minor in a language other than Spanish.					
3	I am taking to many credits as it is, so I do not have time for a foreign language minor.					
4	I am interested in learning Spanish.					
5	I am interested in learning a foreign language but not Spanish.					
6	I would like to have more space in my schedule for foreign language and culture classes.					
7	Being able to speak Spanish will help further my career.					
8	The fact that Spanish are the largest minority group in the U.S. makes it important to learn Spanish in the U.S.					
9	Learning Spanish is/would be engaging.					
10	I find learning foreign languages engaging but not Spanish.					
11	Learning Spanish is/would be challenging.					
12	I find learning foreign languages challenging, but not Spanish.					
13	Learning Spanish is/could be a pleasant experience for me.					
14	Learning a foreign language other than Spanish is/could be a pleasant experience for me.					
15	Learning Spanish is useful.					
16	Learning a foreign language other than Spanish is more useful than Spanish.					
17	I find it interesting to learn about Latin American countries.					

Table 5: Basic outline of the questionnaire used in the study of language attitudes among UNV undergraduate students (cont.)

	Items / variables	Strongly agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Strongly disagree
18	I find it interesting to learn about Hispanics in the U.S.					
19	I am interested in studying abroad in a country where Spanish is the main Spoken language.					
20	I want to study abroad in a country where English is not the main spoken language.					
21	I am aware of study abroad programs at S&T.					
22	I am interested in travelling outside the U.S.					
23	I like getting to know people from other countries.					
24	If you speak English, you don’t need to know any other language.					

Table 6: Correlation Matrix for the variables included in PCA for the study of language attitudes among UNV undergraduate students

	Item 2	Item 4	Item 5	Item 6	Item 7	Item 8	Item 10	Item 13	Item 14
Item 2	1.000	-.205	.300	.184	-.039	-.033	.318	-.010	.299
Item 4	-.205	1.000	-.188	.273	.649	.521	-.424	.712	.049
Item 5	.300	-.188	1.000	.297	-.154	-.181	.577	-.085	.585
Item 6	.184	.273	.297	1.000	.297	.323	.193	.377	.464
Item 7	-.039	.649	-.154	.297	1.000	.609	-.273	.551	.051
Item 8	-.033	.521	-.181	.323	.609	1.000	-.296	.540	.071
Item 10	.318	-.424	.577	.193	-.273	-.296	1.000	-.249	.421
Item 13	-.010	.712	-.085	.377	.551	.540	-.249	1.000	.310
Item 14	.299	.049	.585	.464	.051	.071	.421	.310	1.000
Item 15	-.056	.610	-.140	.299	.685	.688	-.271	.632	.114
Item 16	.265	-.169	.500	.240	-.085	-.126	.454	-.032	.425
Item 17	-.031	.488	-.139	.309	.439	.496	-.250	.555	.145
Item 18	-.048	.490	-.165	.315	.476	.592	-.238	.551	.122
Item 19	-.066	.475	-.174	.294	.512	.523	-.186	.502	.111
Item 20	.209	.066	.245	.395	.209	.235	.301	.203	.383
Item 22	.146	.088	.184	.290	.135	.173	.209	.194	.302
Item 23	.159	.170	.156	.306	.277	.195	.170	.285	.280

Table 6: Correlation Matrix for the variables included in PCA for the study of language attitudes among UNV undergraduate students (cont.)

	Item 15	Item 16	Item 17	Item 18	Item 19	Item 20	Item 22	Item 23
Item 2	-.056	.265	-.031	-.048	-.066	.209	.146	.159
Item 4	.610	-.169	.488	.490	.475	.066	.088	.170
Item 5	-.140	.500	-.139	-.165	-.174	.245	.184	.156
Item 6	.299	.240	.309	.315	.294	.395	.290	.306
Item 7	.685	-.085	.439	.476	.512	.209	.135	.277
Item 8	.688	-.126	.496	.592	.523	.235	.173	.195
Item 10	-.271	.454	-.250	-.238	-.186	.301	.209	.170
Item 13	.632	-.032	.555	.551	.502	.203	.194	.285
Item 14	.114	.425	.145	.122	.111	.383	.302	.280
Item 15	1.000	.015	.527	.563	.531	.235	.204	.278
Item 16	.015	1.000	.014	-.047	-.026	.272	.243	.234
Item 17	.527	.014	1.000	.789	.559	.236	.236	.299
Item 18	.563	-.047	.789	1.000	.549	.237	.148	.256
Item 19	.531	-.026	.559	.549	1.000	.533	.355	.309
Item 20	.235	.272	.236	.237	.533	1.000	.549	.446
Item 22	.204	.243	.236	.148	.355	.549	1.000	.481
Item 23	.278	.234	.299	.256	.309	.446	.481	1.000