A Proposal for an Educational Well-Being Index (EWI) for Undergraduate Course Design*

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Abstract: Every day it is more common to hear around us about the publication of studies, surveys or statistical results about the well-being of people, workers, women in a given country. Indeed, as university professors, our work cannot be independent of the level of well-being of our students. So, in this work, we propose a methodology to asses the students well-being inside a course implementation by what we call the educational well-being index (EWI). We start with a survey that gathers those factors that computing courses' students at our university –of two different levels and majors– consider most important. Our second step is the evaluation –by a group of teachers– of the presence of those factors in different educational models of implementation of the courses. We use principal component analysis to extract, from the student data, the valuations that they expressed in the survey: the principal component of their own measurements on well-being. We work only with the coefficients of the first dimension of the principal component. The third step is a (subjective) valuation of the topics addressed in the survey when considering a particular educational model. Finally, we gather everything together to obtain a well-being index of an educational model that allows their comparison. Besides the methodology, we present and analyze the values obtained from our case study.

1 INTRODUCTION

Traditionally, the *gross domestic product* (GDP) of a country has been calculated and studied as a measure of its economic "health" and of its "growth" rate. Moreover, the economic development of a country has been an indicator of the "progress" of this country and it is usually measured by the GDP. The GDP measures, in money, the goods and services produced in a year and in order to compare different countries among them, we usually use the GDP per capita (Wikipedia, 2024) which has been traditionally a measure of country's development.

However, in recent times, this way of measuring the "growth" or "hegemony" of countries and institutions has been severely criticized. The measure does not take into account people individually but just count them collectively, as just another number. In consequence, the GDP, as a measure of well-being, has been strongly criticized during the last years (Skidelsky and Skidelsky, 2013) and, for instance, the term *growth* has been replaced in some economy schools by postgrowth or *degrowth* (Jackson, 2021; Paulson et al., 2020). In order to avoid problems with the term *growth*, the current tendencies replace it by an assessment of *progress*. Although the study of Welfare economics is not new, it dates back to the 1920s with Pigou's famous book (Pigou, 2013), we can say that it has now become not only fashionable but mandatory to measure the well-being in countries and institutions. One of such measures is the *Social Progress Index* (SPI), that provides a better measure to look at if one wants to compare the progress of countries and/or institutions in terms of their welfare (Social Progress Org, 2024; The Economist, 2023) .

Universities have not been an exception where different general indicators are calculated as measures of the success or failure of the university education process. For instance, if we are interested in how a university is seen in the world, we can look at one of the many available rankings, as for example the *ranking* of the universities (July 2023) (Webometrics, 2023) (see Table 1).

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Table 1: Rank of some institutions in the European Ranking (Webometrics, 2023).

European rank	World rank	Institution
115	314	University Duisburg Essen
116	320	University Wurzburg
117	322	Universitat Politècnica de Catalunya
118	322	Technion Israel Institute of Technology
118	326	London School of Hygiene & Tropical Med.

The recent COVID pandemic has made clear that it is necessary to look beyond the classic global indicators –especially as a result of the multiple mental health problems it has generated in society. It is needed to look closely at the people individually and in particular pay attention to their well-being. Many studies of well-being at the university or campus level have appeared in the last years; see, e.g., (Dodd et al., 2021; Wang et al., 2022; Kanonire et al., 2022). At a lower level, the success of a course is usually measured by general indicators such as the pass rate although there are discussions on the teaching methodology that a traditional face-to-face institution should adopt in the future and we believe that such evaluations need to take into account a measure of well-being. In this work, we propose the *Educational well-being index* (EWI), inspired in the SPI (Social Progress Org, 2024), to assess the well-being of the design of a course at university level. We exemplify our proposal with a case study made on a relatively small sample of students and several educational models.

To do so, we prepared a well-being questionnaire formed by 20 well-being related questions to be ranked between 1 and 5. We poll the students of two different courses at the Universitat Politècnica de Catalunya (UPC): Programming I (first year Math studies) taught at the Facultat de Matemàtiques (FME) and Algorithms (third year CS studies) at the Facultat d'Informàtica de Barcelona (FIB)to determine the elements that conform –according to them– their well-being at university courses. We perform a *Principal component analysis* (PCA) on the gathered data to extract the first principal component (as it is done to compute the SPI) which provides a quantification of the value of each question.

Aside, we consider the three dimensions of teaching that we believe have impact on well-being: *lecturing*, *transportation*, and *school models*. The first dimension considers four different models to teach the above-mentioned courses from totally in person to as much online as possible in our university. Let us observe that we focus on a university that offers only *synchronous education*, meaning that in class hours students and lecturers coincide either on-line or in person. The transportation dimension considers the type of mobility needed to reach the university campus, for example, cheap/expensive or long/short. The school dimension takes into account the organizational model which has particular trends in different schools. Each combination of one model from each dimension provides a description of a potential educational model.

For each educational model, we evaluate the amount of the well-being components that conforms it by grading –following our own opinion– the questions relative to the model in the survey. Finally, we use the results of the PCA to provide a comparable rank value. We name this value as EWI as an equivalent of the SPI for courses. We study the trends and components of our proposed index analyzing the tendencies and singularities of our case study.

The paper is organized as follows: in Section 2 we give the required preliminaries on SPI. In Section 3 we present the design of the student's poll. Then, in Section 4, we present the different course implementation models and our evaluation of them with respect to the well-being elements. In Section 5, we provide the EWI ranking of the course implementations, according to our data, and analyze the tendencies by component. Finally, we provide some conclusions and lines of future work in Section 6.

2 WELL-BEING: THE SOCIAL PROGRESS INDEX

The *social progress index* (SPI) is informally defined in (Social Progress Org, 2024) as

> The capacity of a society to meet the basic human needs of its citizens, establish the building blocks that allow citizens and communities to enhance and sustain the quality of their lives, and create the conditions for all individuals to reach their full potential.

The SPI considers only non-economic aspects of the countries. The indicators (a total of 60) are organized in three dimensions: 1) Basic Human Needs, 2) Foundations of Well-being, and 3) Opportunities. Each dimension contains four *components*. Our interest is in the second dimension, that considers the following components:

- *Access to Basic Knowledge*

Table 2: Countries and rankings; four indicators: (1) Social Progress Index (SPI) in 2022; (2) Gross Domestic Product (GDP) according to FMI 2013; (3) CO_2 emissions in 2021; and (4) Most highly ranked university in the country in 2023.

Country	SPI	Rank	GDP (k$)	Rank	CO_2t per cap.	University	Rank
Sweden	89.42	6	58.014	7	3.82	Lund Universtiy	123
Germany	88.72	8	44.999	18	8.06	TU München	86
UK	86.13	19	39.372	23	4.95	Oxford University	4
France	86.04	20	44.099	20	4.58	Sorbonne University	227
Spain	85.35	21	29.150	27	4.99	Universitat de Barcelona	108
Italy	85.23	22	34.715	26	5.41	Università di Bologna	105
Greece	82.44	33	21.857	35	4.82	Patras University	571
Canada	88.17	10	52.037	10	14.86	Toronto University	16
USA	84.65	25	53.001	9	14.24	Harvard University	1
Israel	83.17	31	36.926	25	6.74	Tel Aviv University	115
Chile	80.78	36	15.776	45	4.61	Universidad de Chile	300
Argentina	78.64	41	14.709	50	4.12	Universidad de Buenos Aires	382
Mexico	70.84	66	10.650	64	3.09	Universidad Nacional Autónoma	108

- *Accent to Information & Communication*
- *Health & Wellness*
- *Environmental Quality*

It seems that, at least in developed countries wealth and well-being are strongly correlated but not always coincide as we can see in the SPI. Concerning *Environmental Quality*, the main interest is on climate change due to CO_2 emissions which is, as for today, an unavoidable problem (Nordhaus, 2013).

In order to quantify some specific trends on the different approaches, in Table 2, we give the SPI, GDP, CO_2 emissions and the best *University rank* for some countries. The different values of the parameters show an up-and-down across countries and numbers. Some countries demonstrate strengths in certain topics while displaying weaknesses in others.

For instance, if we compare Spain and EEUU, we can observe that Harvard is the best world and EEUU university, while the best Spanish university, Barcelona U., is ranked 26. The GDP per capita in EEUU (53k$) is much larger than in Spain (29k$). However, in some aspects, Spain seems to be better than EEUU; Spain is slightly better ranked in SPI than EEUU. The difference becomes greather when we look at CO_2, 4.99t in Spain and 14.24t EEUU. We could summarize (perhaps simplifying too much) saying that people in EEUU are more rich and have better universities than in Spain, but people in Spain have a better well-being and pollute less.

3 QUESTIONNAIRE DESIGN

The first thing that we did was to identify which of the topics listed in the SPI report were applicable to university education on computing (and to university education in general). Once these topics were identified, we created a list of 20 statements. For each of them we add a question of the form: *From 1 to 5, how important is the topic T for your well-being in the subject, school, university, etc.* with the idea of surveying the largest number of students possible.

As we have already mentioned, we concentrate in three dimensions:

- *Lecturing*
- *Transportation*
- *School*

The first dimension consider question related to the ways of teaching. In particular the relevance from the well-being perspective of having face-to-face or on-line interactions. The second dimension addresses one natural complaints, especially when reaching the university requires some time, which has a clear impact in well-being. On the other hand, all of us have a clear idea that public transportation is better than private but here we are using a point of view of CO_2 production. Our questionnaire focus on the comfort of traveling and not on the division public/private mobility. The third dimension, consider the institution that is organizing the teaching. In our context, the school is the agent that controls the use of resources. The school decides the time tables, the class rooms, the placement of the exams, the sizes of the groups, etc.

4 EDUCATIONAL MODELS

As we already mention we focus only in what we call “synchronous education”: at class time students and lecturers are both present either in-person

or in streaming. In order to identify which educational models fit better with those well-being topics that our students consider more important, we considered three dimensions:

- *Type of lecturing*
- *Transportation*
- *Resources and organization*

4.1 Type of Lecturing Classes

We consider four different ways of teaching the classes of the two courses on which we based our study. These follow the different combination of face-to-face and on-line interaction that we experimented during the pandemics. Each type is set by fixing the percentage of in-person requirements for each of the following parts of the course: a) theory classes, b) problem classes, c) laboratory classes, d) video taped classes and e) assessment. Table 3 shows the percentage of in-person attendance of each of the four ways of lecturing.

4.2 Transportation

One of the factors influencing well-being is the kind of journeys needed to reach a university campus. In our university, we were able to identify three kind of campuses: a) campuses in which the duration of the average journey is less than 30 minutes, b) campuses in which the duration of the average journey is greater than an hour and a half and c) campuses in which the average journey duration is in between the other two.

For the first kind of campus, we observed that the students transportation is mainly by means of public transportation. It is questionable but we considered –arbitrarily– that public transportation is less comfortable than private one but cheaper. Therefore, we have considered that the journeys on public transportation only were pretty uncomfortable (assigning a 1 value in the corresponding question) and inexpensive (assigning a 5 value in the corresponding question). As distances are higher, the use of public transportation decrease, so for the second one we assume the percentage of public transportation to be around the 30%. Thus, we assigned values of 5 in comfort (completely comfortable journeys) and very expensive (assigning a 1 value in the corresponding question). For the third, it is likely to be 50% public transportation and the rest private. Consequently all the assigned values were in the middle (assigning them a value 3). The reason to these choices was to include in the kinds of transportation all the possible contrast of values.

Table 3: Percentage of in-person attendance according to the type of classes.

Type	L_1	L_2	L_3	L_4
Theory	100%	0%	0%	100%
Problems	100%	0%	0%	50%
Laboratory	100%	0%	100%	0%
Videos	0%	100%	50%	50%
Assessment	100%	50%	75%	75%

Table 4: Percentage of use of public transportation in students journeys to university campuses.

Type	Campus T_1	Campus T_2	Campus T_3
Public	100%	30%	50%
Private	0%	70%	50%

4.3 School Types

The FIB offers a Computer Science degree with four different specialties. Each generation consists of approximately 400 students who study subjects from a common two-year core and then choose a specialty from among four possible ones: computing, software engineering, information systems and hardware. The theory classes are divided into groups of 60 students while the laboratories are conformed by 20 students. There are lectures in the morning and afternoon for all subjects and an enrollment order is imposed in which the students choose the lecture times that they want according to their average grade. In general, the students do not feel that they are part of a group –since it can change semester to semester and from one subject to another, even from theory classes to laboratory classes. In summary, we consider this school as a large one in which students do not group together in a single group but are grouped into small groups according to friendships and affinities.

For its part, the FME offers the degree in Mathematics without independent specializations. Each cohort consists of approximately 75 students. The theory classes are divided into groups of 35-40 students while the laboratories have a maximum of 30 students. There are classes only in the morning for all subjects and students are in the same group for both theory classes and problem classes throughout their entire degree. For this reason, a lot of cohesion is created among all the students of this school. In contrast to the FIB, the FME is a small school in which all the students of the same generation (and even from different generations) work closely together and form a kind of big family.

Both schools also have students' associations, although for the reasons we explained before, FME's students participate in them more actively than FIB's students. The same goes for the social and academic

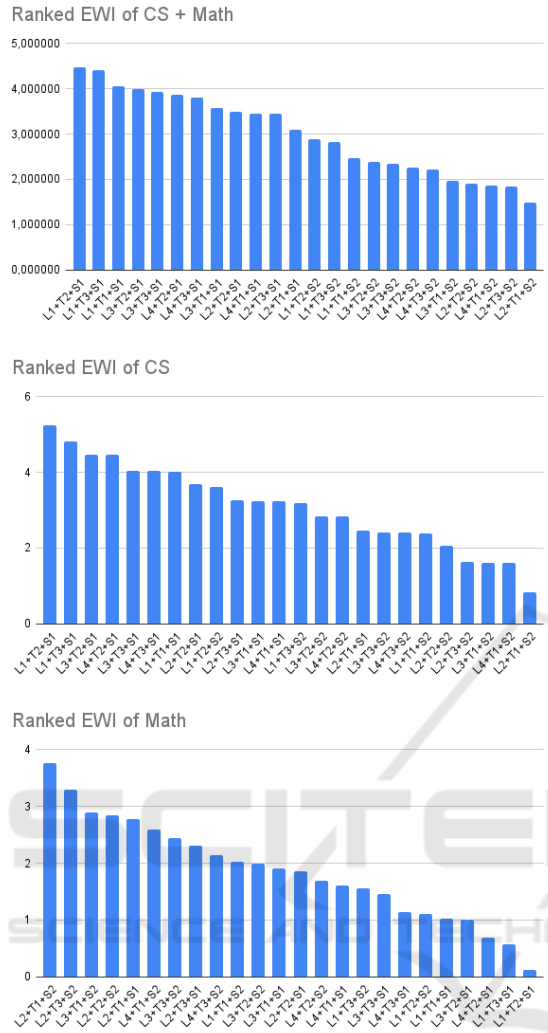


Figure 1: Ranked EWI of the different models for the considered populations.

activities that both schools offer to their students.

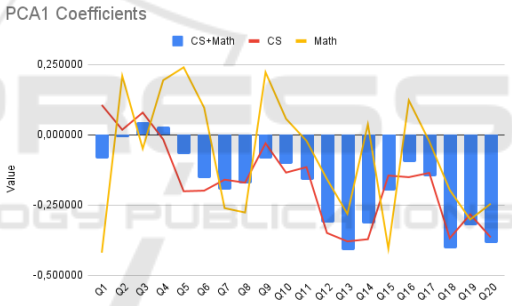
In order to provide support to students, it is also possible in both schools (for those students who request it) to have a tutor (a lecturer who can advise them on academic issues) and a mentor (a student of more advanced courses who guide them in the first years of studies). As expected, FME's students tend to ask for mentors more frequently than FIB's students and although they do not formally request them, the cohesion between students in FME is so strong that students from more advanced courses usually act as mentors for newly arrived students.

4.4 Educational Models and Well-Being

Finally, we define educational models as 3-tuples selecting the types of lecturing (4), transportation (3) and school (2). This gives a total of 24 combinations defining the educational models considered in this paper. For each of them, we calculate how present were –in the model– each of the 42 topics of the survey. Our topic assessment is personal, following from our experience in teaching and our perception of the relevance of the topics according to the selected parameters.

Table 5: Coefficients of the 1st PCA component for the considered populations.

Question	PCA1 coefficients		
	CS + Math	CS	Math
Q_1	-0.085275	0.105952	-0.419600
Q_2	-0.009672	0.017823	0.209514
Q_3	0.044217	0.079005	-0.049599
Q_4	0.029739	-0.016453	0.194054
Q_5	-0.068040	-0.200985	0.239976
Q_6	-0.154504	-0.198831	0.096388
Q_7	-0.196589	-0.159725	-0.260992
Q_8	-0.174137	-0.170388	-0.276614
Q_9	-0.084349	-0.030297	0.222551
Q_{10}	-0.103875	-0.134508	0.056949
Q_{11}	-0.159900	-0.115195	-0.021422
Q_{12}	-0.313385	-0.349402	-0.157717
Q_{13}	-0.409164	-0.379408	-0.281585
Q_{14}	-0.314704	-0.371641	0.037266
Q_{15}	-0.198096	-0.145104	-0.405415
Q_{16}	-0.096386	-0.150898	0.122577
Q_{17}	-0.147899	-0.135657	-0.023578
Q_{18}	-0.403038	-0.367978	-0.196697
Q_{19}	-0.322291	-0.283208	-0.301314
Q_{20}	-0.384016	-0.364963	-0.245365



5 THE EDUCATIONAL WELL-BEING INDEX

Here we relate the components of Sections 3 and 4 to obtain the EWI. Our index allows us to evaluate the 24 educational models considered in the previous section in relation to what the surveyed students consider important for their well-being.

The first step is to use the data gathered in the poll to extract the relevance of each of the topics included

in the survey. For doing so, we use the principal components analysis (PCA) statistical method, that reduces categorized data to their essential features, the so-called principal components. The principal components are linear combinations of the original variables. The coefficients in the linear combination are obtained so that the direction maximally explain the variance of all the variables. In general, the method provides an approximation of the original data table using only these few major components. Following the SPI definition, we only consider the first component of the PCA. This approach allows us to rank by its relative importance each one of the well-being factors of the survey. This rank is a projection on the first component of the PCA.

On the other hand, in Section 4, we provide an assessment (subjective to our view) on how present are each of the factors considered in the survey within each of the proposed educational models. We obtained this assessment by subjectively grading the same survey that we had administered to the students for each of the 24 possible models.

To obtain the EWI of an educational model, we use the coefficients of the first component of the PCA to assign an index value to each educational model. We multiply the value (duly scaled) given to each question (or factor) by the coefficient of the question in the first PCA component of the students responses. This allows us to position each model on the principal component axis in such a way that the higher the value of the corresponding model on that axis, the more correlated the model is with the principal component, or in other words, the higher the value obtained for each model, the better the model adapts to what students consider important for their well-being.

In our case study, we wanted also to analyze the sensibility of the model to a population. For doing so, we performed the PCA analysis on three data sets: the CS, the Math, and the aggregated CS + Math. In Figure 1, we depict the sorted values of the EWI, for the three data sets. In Table 5, we present the coefficients of the PCA. As the two considered population appear to have different sensibilities towards well-being, none of the three rankings coincide. Let us look to the PCA coefficients for questions in the lecturing dimensions. Having in-person classes (Q_1) gets positive weight in EWI from CS and negative in the other cases, while having them broadcasted live (Q_2) gets negative weight in the global data but positive in the others. Having offline classes prerecorded (Q_3) gets negative weight only from Math and broadcasting platforms (Q_4) only from CS.

It is also worth mentioning the weighting of the questions in the transportation dimension. Traveling time (Q_5) and comfort (Q_6) get positive weight in EWI from Math and negative in the other cases. This might be explained because there are more CS students and usually their schedule is quite chaotic while Math students are less and usually have compact schedules.

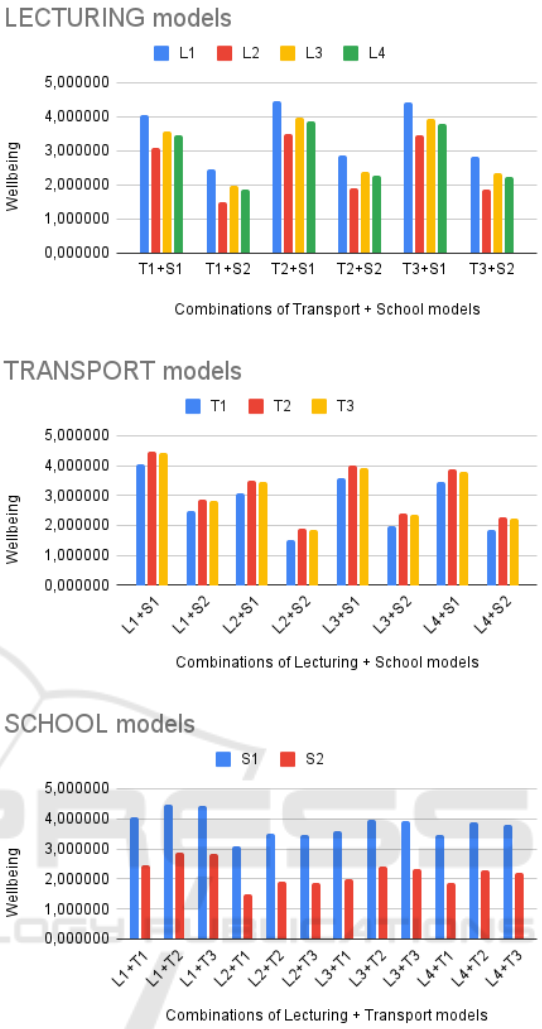


Figure 2: The EWI per dimension taking the PCA of the poll from both CS and Math students.

In Figures 2, 3 and 4 we depict the results of the EWI rankings per dimension. Under this point of view, we can visualize better the variations of the EWI when fixing a dimension. Analyzing the school dimension, we can see that the EWI of the educational models follow the same tendencies in the three cases. Using CS data, models with S_1 get higher values of EWI than models with S_2, the situation is reversed for the Math data. When dealing with the complete data set, the tendency seems to be dominated by the FIB population. This is in accordance with the fact that

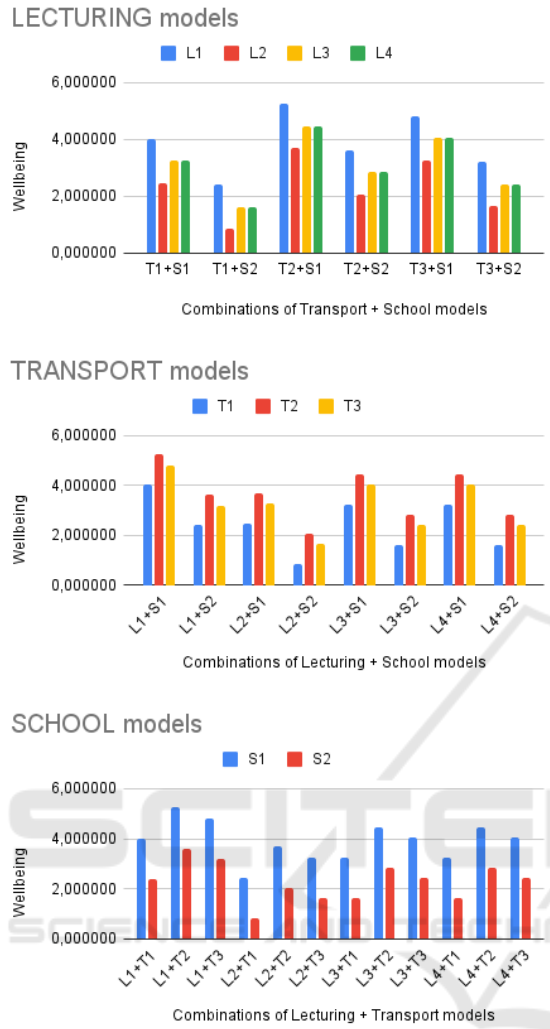


Figure 3: The EWI per dimension taking only the answers of the CS students in the PCA.

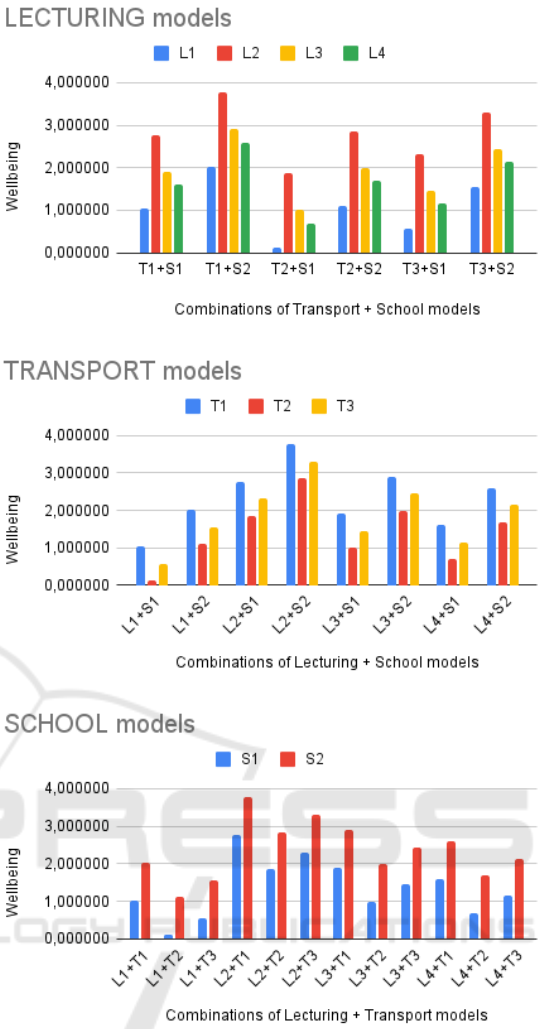


Figure 4: The EWI per dimension taking only the answers of the Math students in the PCA.

when weighting school dimension, we have in mind most trends of CS for S_1 and more from Math for S_2. A further interpretation is that in both populations, the EWI increases in models considering a school model similar to the chosen one.

From the point of view of the transportation one can observe variability in the three models, while in the lecturing dimension, models L_1 and L_2 present the most different influences in the index. We do not have any explanation of the changes of the EWI due to these components. We suspect that there are some relevant correlations between the lecturing and transportation models that require further study to be explained.

6 CONCLUSIONS AND FUTURE WORK

At present, where the economic growth has been widely criticised, the well-being appears as a fundamental issue. Recently, the importance of measuring well-being has been recognized as a relevant tool in the evaluation of countries, institutions, communities and individuals in addition to the classic indicators used in economics. We can say that, as individuals, the well-being of every one is a personal concept that depends at least in part on our worldview (weltanschauung). Therefore, the well-being has also many components and can be analyzed at different levels. We have proposed and study the EWI as a measure of well-being for educational models to be used as an a

priori appraisal when designing a course implementation. The EWI relies on parameters extracted from a student valuation of some well-being topics. As the student were taken from sectors with diverse interests, we have been able to see that the index is sensible to the trends of the selected population. In the coming semesters, we plan to run a similar poll but asking for the valuation of the topics in the context of the course. This will help us to validate the result and understand better the applicability of the index.

The student's well-being is a multidimensional concept, in this paper we have focused only in three of the many possible dimensions, namely lecturing, transportation and school facilities, but many other could be incorporated in the index. Note that, some of these aspects, like facilities or public transportation, are external to the pedagogical aspects of course organization. Our proposal could be adapted to other environments or interests, by redefining dimensions and the corresponding topics of interest. We plan to extend the survey on well-being to a bigger population of students from CS and Math and look into more than one dimension of the PCA. It will be also worth to perform a factor analysis to identify the relevant topics in every considered dimension.

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