I Use statistics in education

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Many literacies

- *Language literacy*
- *Mathematics literacy*
- *Computer literacy*
- *Ocean literacy*
- *Science literacy*
- *Critical literacy*
- *Social literacy*
- *Relational literacy*
- *Sexual literacy*
- *Spatial literacy*

And more ...

http://1.bp.blogspot.com/-4_JVJFugTgw/Ub_ME8TGkpI/AAAAAAAAeXg/Rm5qoUDqYBk/s1600/information+literacy.png

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Literacy as stepstone to citizenship

Education for citizenship

- **equips young people with the knowledge, skills** and understanding to play an effective role in public life
- encourages them to take an interest in topical and controversial issues and **to engage in discussion and debate.**
- learn **to take part in decision-making and different forms of action.**

They **evaluate information, make informed judgements** and reflect on the consequences of their actions now and in the future. They learn to argue a case on behalf of others as well as themselves and speak out on issues of concern

http://www.teachingcitizenship.org.uk

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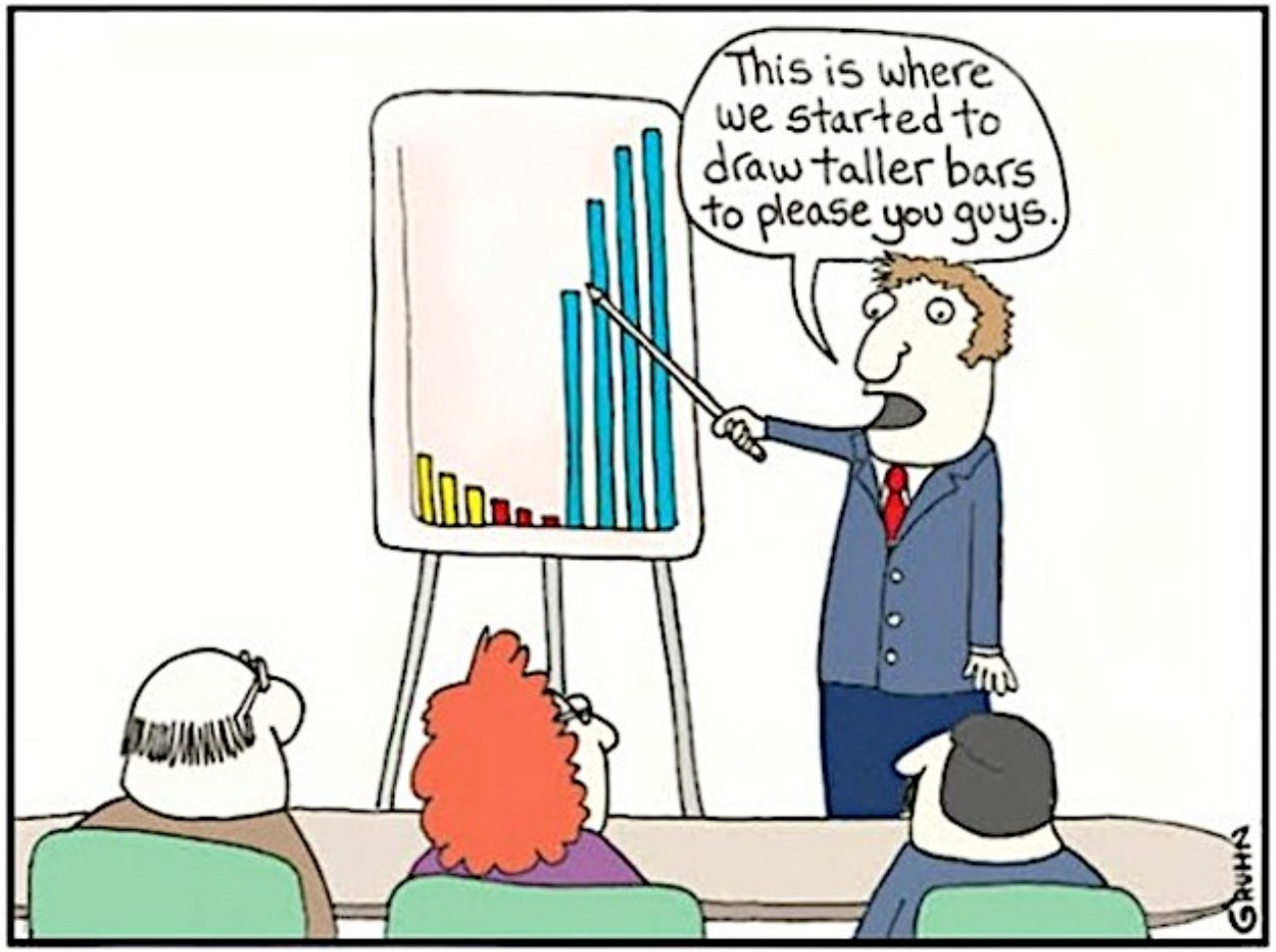
Why statistical literacy?



http://4.bp.blogspot.com/-dBMk6ciM4QI/TgiaQ-GuaCI/AAAAAAAAAAY/Hcd8lVRIOyA/s1600/Statistic%2Bcartoon.jpg

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Statistics - everywhere

- Every activity relies on statistics – one way or the other
- Today easy vivid presentations: figures, charts, living and interactive diagrams and graphs,
- Useful tool in aiding research and studies in economics, social sciences, business, medicine ...


you are statistics!
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Source: U.S. Departmer
1,022,494
Afghanistan
2,887,123
1,739,935
Pakistan
1,740,711
China
World refugees under UNHCR
Total
10,396,540
900

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Importance and need of statistical literacy

http://streetsmartproductmanager.com/tag/product-management/

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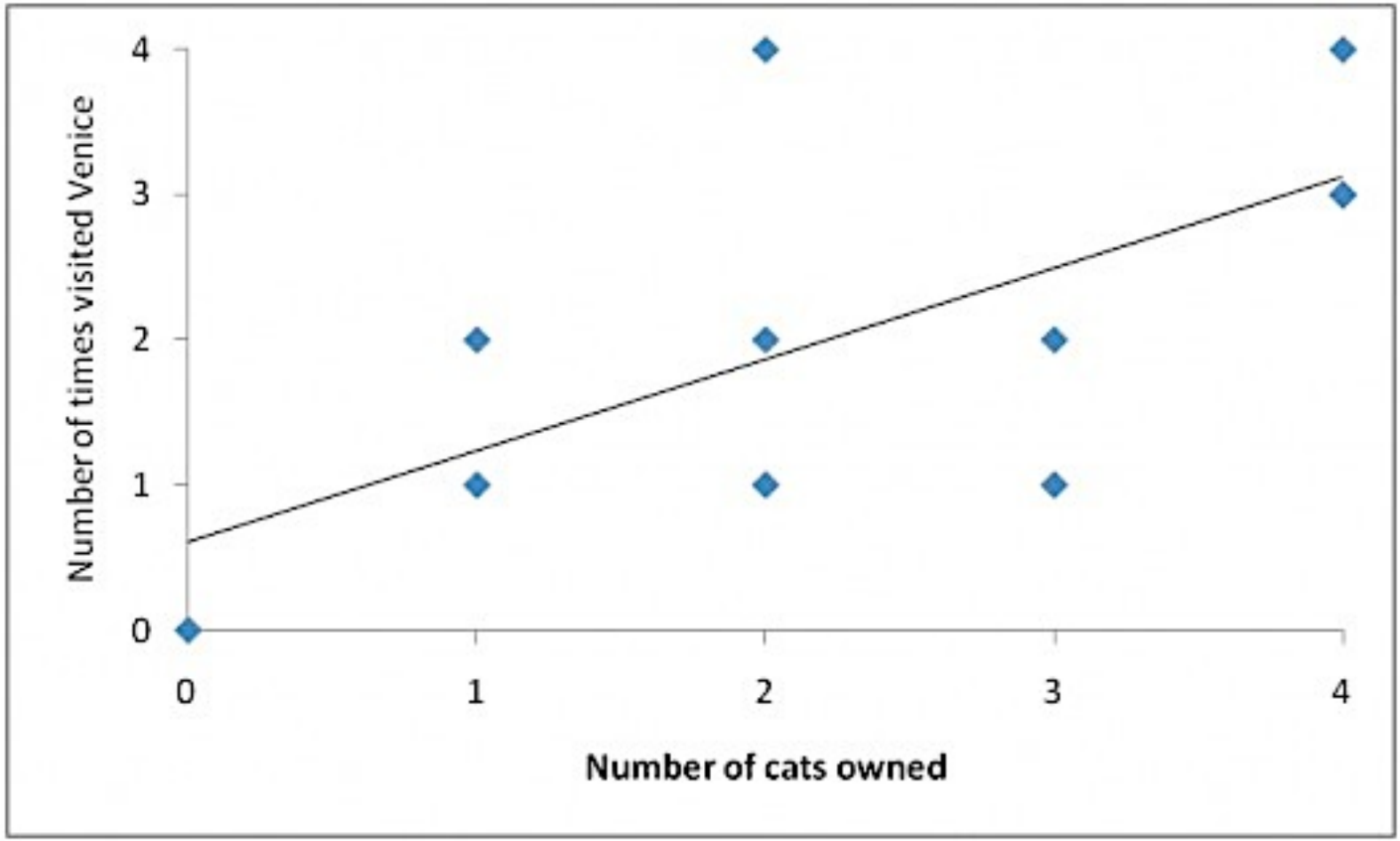
Statistics can prove ... Anything?



http://www.fuelyourblogging.com/how-to-prove-anything-with-statistics/

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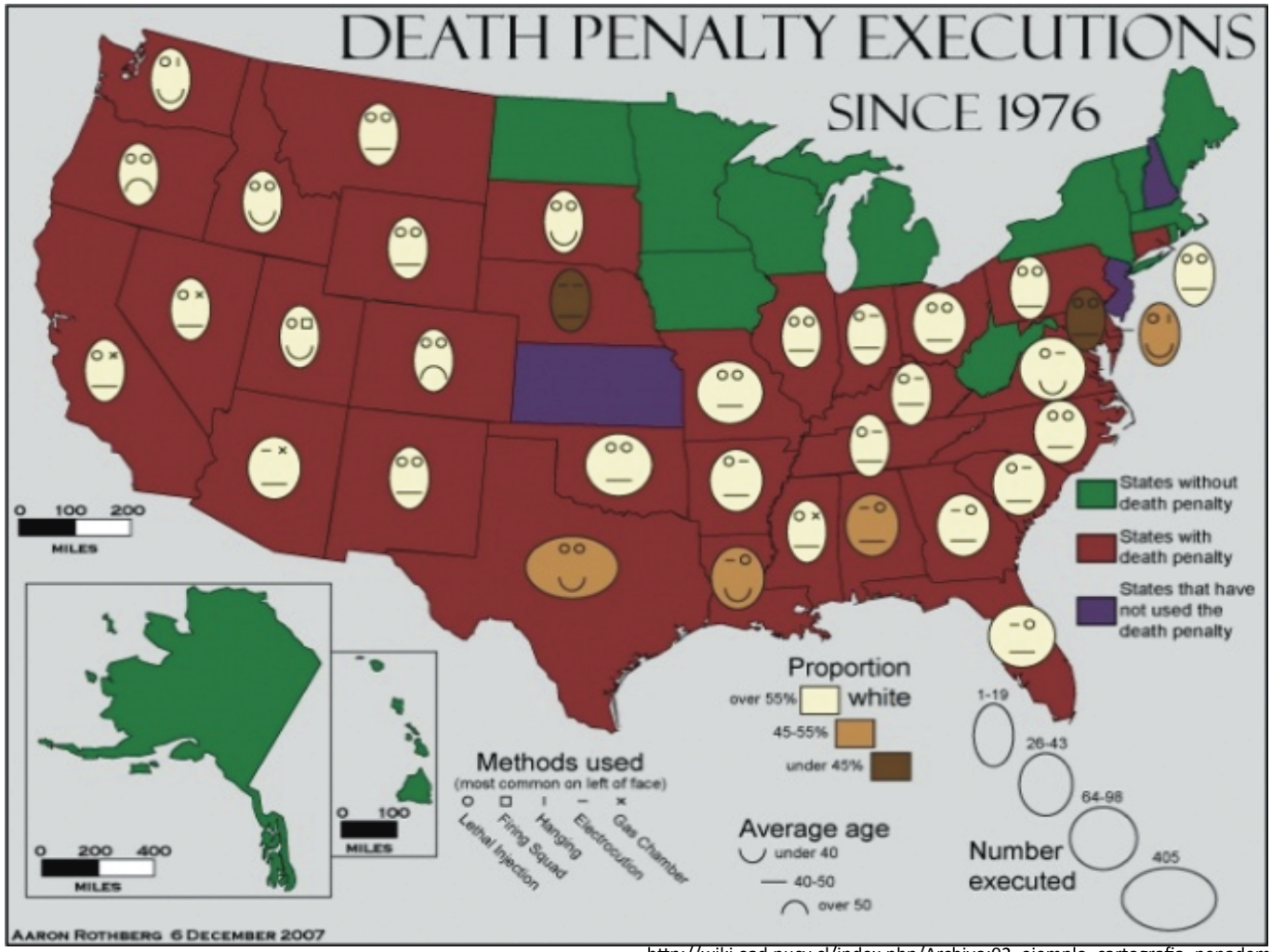
… and how is it visualised?



http://wiki.ead.pucv.cl/index.php/Archivo:02_ejemplo_cartografia_penademuerte_chernoff.jpg

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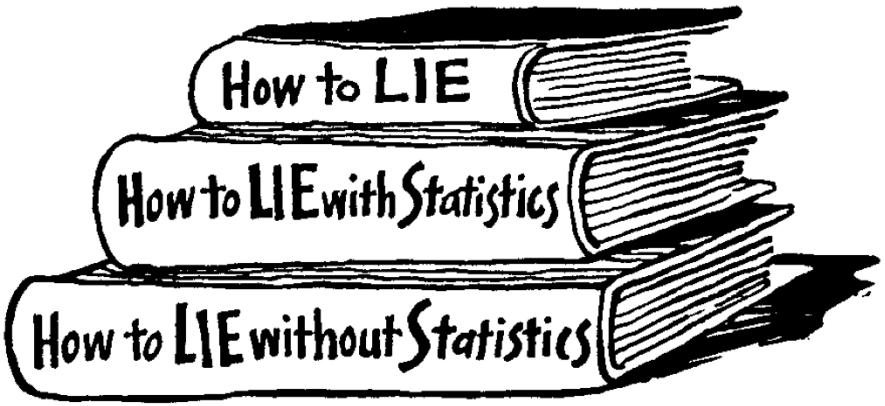
Importance and need of statistical literacy

- "*to be an intelligent citizen it is necessary to know something about statistics*", research of Begg and Edwards (1999) and Chick and Pierce (2008).
- Solid background to the use and interpretation of statistics in education is very important, especially in the STEM subjects



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Importance and need of statistical literacy

- Statistics as a content domain is widely accepted

typically taught as part of mathematics

- Used to show a result instead of doing real analysis and investigation.

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Mapping 'Statistics' across Europe: overall quantitative content analysis results

Subject / Country	Maths & Statistics	History	Science (Physics, Chemistry, Biology)	Geography	Social Science (Civics, Sociology)	Economics	Total
Belgium (Flemish)	20	2	10	14	-	-	**46**
Denmark	26	1	5	5	14	-	**51**
Sweden	9	1	1	3	1	-	**15**
International Baccalaureate	26	1	6	6	2	-	**41**
Greece	76	28	12	74	14	66	**270**
Czech	10	-	-	5	3	-	**18**
Total	167	33	34	107	34	66	**451**

China
Milliardenvolk auf engem Raum

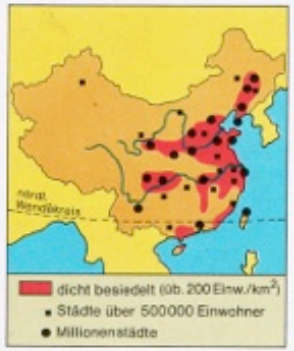


Bild 1 (Seite 121)
In Schanghai

Bild 2
Auf dem Weg zum freien Markt

Zhu Wu hat gut lachen. Er ist auf dem Weg zum freien Markt in der Millionenstadt Xi-an, der Provinzhauptstadt von Shaan-xi, wo er möglichst viele Hühner verkaufen will. Zhu hat heute seinen freien Tag, und da will er ein beachtliches Sümmchen dazuverdienen. Seine Frau braucht unbedingt eine Nähmaschine – möglichst eine mit Fußantrieb. In der Stadt kann man zwar auch elektrische Nähmaschinen kaufen, aber dies ist für ihn viel zu teuer.

Die Hühner auf seinem Fahrrad leben alle noch! Er kann sie doch nicht schon vorher schlachten, bevor sie verkauft sind. In seinem Dorf hat noch niemand eine Tiefkühltruhe oder einen Kühlschrank, in dem man die unverkauften Hühner lagern könnte. Er selbst kann sich nur selten etwas Fleisch oder gar Fisch zum Essen leisten. Meistens kocht seine Frau eine Reismahlzeit mit etwas Gemüse. Dazu trinkt man immer Wasser oder Tee.

Eben ist Herr Wu von einem Lastwagen der Brigade überholt worden, der Jugendliche zu einer Sportveranstaltung bringt. Solche Ausflüge bringen etwas Abwechslung in den Alltag der Menschen. Vor kurzem hat auch Herrn Wus Brigade einen Ausflug mit dem LKW zu einer alten Tempelanlage gemacht, denn Privatautos gibt es in China kaum. Auch die Mutter von Zhu durfte teilnehmen und der kleine Djiän-guo – das bedeutet »Aufbau des Landes«.

Bild 3
Im Kindergarten

1 Wachstum und Verteilung der Bevölkerung

Herr Wu hat nur einen Sohn; aber er hätte gerne noch viele Kinder, denn er selbst ist in einer kinderreichen Familie aufgewachsen. Früher mußten gerade die Bauern viele Kinder großziehen, weil sie diese zur Arbeit brauchten. Außerdem waren die Söhne verpflichtet, für die Kranken und alten Eltern zu sorgen.

Dem Milliardenvolk der Chinesen geht es aber heute darum, die Zahl der Kinder zu senken, damit alle ernährt und beschäftigt werden können. Über 500 Millionen Chinesen sind derzeit unter 20 Jahre alt! Um das Bevölkerungswachstum »in den Griff zu bekommen«, wirbt der Staat in Rundfunk und Zeitungen und auf Versammlungen für die Ein-Kind-Ehe. »Später – seltener – weniger« lautet die Parole zur Geburtenplanung. Familien mit einem Kind werden bevorzugt behandelt: bei der Zuweisung von Arbeitsplätzen und Wohnungen sowie bei der Sicherung der Altersversorgung. Sie erhalten ein zusätzliches Monatsgehalt im Jahr, mehr Urlaub und Kindergeld. Der Besuch von Kindergarten und Schule ist kostenlos. Ab dem zweiten Kind müssen die Eltern höhere Steuern entrichten, und sie erhalten kein zusätzliches Privatland. Alle sonstigen Vergünstigungen wurden gestrichen. Ab dem dritten Kind wird das Einkommen gekürzt.

Chinas Bevölkerung wächst jährlich trotz dieser harten Maßnahmen um 1,5 Prozent! Und die Masse der Jugendlichen kommt demnächst ins heiratsfähige Alter. Bis zum Jahr 2000 soll das Bevölkerungswachstum auf Null gedrückt werden. Aber was in den Städten möglich ist, muß nicht unbedingt auf dem Lande gelingen.

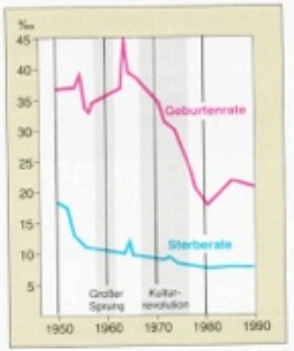


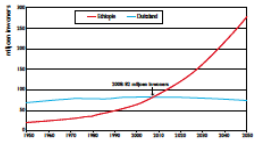
Bild 4
Natürliche Bevölkerungsentwicklung Chinas

1.1 Beschreibe die Bevölkerungsverteilung Chinas (Atlas, Pilotkarte).
1.2 Nenne Maßnahmen, mit denen in China das Bevölkerungswachstum eingegrenzt werden soll. Warum lassen sich solche Maßnahmen leichter in den Städten als auf dem Lande verwirklichen?

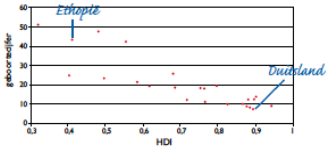
Population study of China in a typical 1980's schoolbook (Diercke Erdkunde für Gymnasien in Nordrhein-Westfalen Industriestaaten und Entwicklungsländer 8, 1986)

3.7 Ontwikkelingslanden versus industrielanden: een eigen demografisch onderzoek

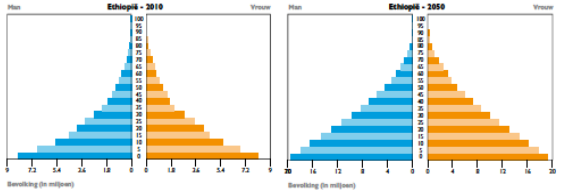
Onderzoek de evolutie van de bevolking van Ethiopië en Duitsland. Raadpleeg de tabel op p. 26 en de grafieken hieronder. Noteer je bevindingen in de tabel op de volgende pagina. Plaats eerst de namen van beide landen bij de overeenkomstige stip op fig. 1.37.



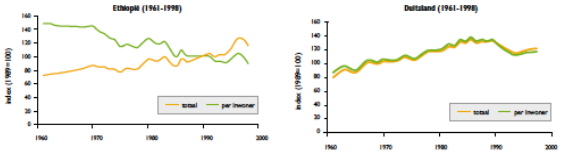
1.36 De evolutie van de bevolking in Ethiopië en Duitsland



1.37 De relatie tussen geboortecijfer in ‰ en HDI



1.38 Leeftijdshistogrammen van Ethiopië en Duitsland in 2010 en 2050



1.39 Evolutie van de totale voedselproductie en de voedselproductie per inwoner

	Ethiopië: een ontwikkelingsland	Duitsland: een westers industrieland
regio	*sub-Sahara Afrika*	*West-Europa / EU*
bevolking in 2008 (fig. 1.36)	*82 miljoen inwoners*	*82 miljoen inwoners*
prognose voor 2050 (fig. 1.36)	*280 miljoen inwoners*	*75 miljoen inwoners*
natuurlijke groei (tabel p. 26)	*3,21 %*	*-0,28 %*
vruchtbaarheid per vrouw (tabel p. 26)	*6,07*	*1,42*
levensverwachting (tabel p. 26)	*55,8 jaar*	*79,4 jaar*
huidige leeftijdsstructuur van de bevolking (histogrammen of atlas) • jongeren (0-14) • actieven (15-64) • ouderen (65 en ouder)	*groot: brede balkjes / > 40 % (46,4 % in 2010)* *51,1 % in 2010* *klein: smalle balkjes < 2,5 % (2,7 % in 2010)*	*klein: smalle balkjes / < 20 % (13,5 % in 2010)* *66,1 % in 2010* *groot: brede balkjes >15 % (20,4 % in 2010)*
fase in de demografische transitie + kenmerken	*GC = 43,3 ‰, het SC = 11,3 ‰* *Fase 2 of de vroege expansiefase*	*GC = 8,2 ‰, het SC = 11 ‰* *Fase 5 of de afnemende fase*
analfabetisme (atlas)	*50 - 75 %*	*< 5 %*
armoede (atlas)	*> 50 % leeft met minder dan $ 1*	*< 5 % leeft met minder dan $1*
verstedelijkingsgraad (atlas)	*< 25 % leeft in steden*	*> 75 % leeft in steden*
evolutie van de voedselproductie	*De totale voedselproductie stijgt, maar door de snelle groei van de bevolking neemt de voedselproductie per inwoner af.*	*Voedselproductie en bevolking stagneren, zijn in evenwicht.*
draagkracht	*Wordt overschreden, een groot deel van de bevolking is ondervoed en lijdt armoede.*	*De bevolking heeft meer dan voldoende inidddelen van bestaan.*
maatschappelijke gevolgen van de bevolkingsevolutie	*Door de zeer snelle groei van de bevolking dreigt de voedselvoorziening in gevaar te komen. De overheid die instaat voor meer werkgelegenheid, gezondheidszorg, onderwijs… voert een voortdurende wedloop tegen de tijd.*	*De bevolking wordt snel ouder. Er zullen te weinig actieven zijn om hen te onderhouden.*
maatregelen die de overheid neemt	*Voorlichting bij familieplanning, verbeteren van de welvaart (bbp/inw., onderwijs, gezondheidszorg …)*	*GC laten stijgen: kindergeld, voldoende opvang voor kinderen, ouderschapsverlof… Seniorenboom: optrekken van de pensioenleeftijd, stimuleren van pensioensparen …*

Noteer hier je bevindingen i.v.m de verdere evolutie van de bevolking.

In Ethiopië en Duitsland wonen er ongeveer evenveel mensen. Ethiopië zit nog volop in de vroege expansiefase, met zeer veel geboorten en afnemende sterfte. Hierdoor kent het land een explosieve groei. Tegen 2050 zal de bevolking in Ethiopië meer dan verdrievoudigd zijn, terwijl die van Duitsland zal krimpen tot 73 miljoen. De bevolking in Duitsland is sterk vergrijsd en het geboortecijfer is er laag. Duitsland bevindt zich al in de afnemende fase.

Saudi-Arabië	25 731 776	10	10,1	3,66	3,66	1,08	1,2	5,4	71,1
Taiwan	23 024 956	11,1	16	-0,01	-0,05	-0,24	2,23	2,8	80,3
Turkije	77 804 122	19,4	3,3	-0,49	-0,47	-0,24	7,68	28,6	82,2
Uganda	33 398 682	9	6,9	1,61	1,55	-0,08	1,29	114,5	75,7
VK	62 348 447	18,3	6,1	0,21	0,21	1,08	1,41	6,7	53
VS	310 232 863	47,6	11,9	1,22	1,27	3,66	2,35	10,3	75,9
Zuid-Korea	48 636 068	12,3	9,3	3,57	3,56	3,66	1,15	16,7	66,2
		13,8	8,4	0,3	0,56	0,97	2,18	5,3	73,9
		8,7	6,2	0,55	0,26	0,26	6,73	24,8	78,2
							1,92	63,7	68,2
							2,06	4,7	53
							1,22	6,1	79,9
								4,2	6,1
									78,8

totale groei (in %)	vruchtbaarheids-cijfer (aantal kinderen per vrouw)	kindersterfte (in ‰)	levens-verwachting (jaar)	HDI
1,55	2,65	52,5		
0,08	1,65	4,4	69,4	0,497
1,17	2,19	21,9	79,4	0,867
0,49	1,54	16,5	72,3	0,764
3,17	6,11	79,4	74,5	0,718
-0,06	1,42	4	54,7	0,555
3,2	6,07	79	79,4	0,885
1,93	3,23	19,9	55,8	0,412
0,53	1,97	3,3	71,4	0,681
1,72	3,17	81,4	81,1	0,897
1,38	2,65	49,1	29,9	0,404
1,1	2,28	28,9	66,5	0,585
	1,32	5,4	71,1	0,686
	1,2	2,8	80,3	0,886
	2,23	28,6	82,2	0,894
	7,68	114,5	75,7	0,618
	1,29	6,7	53	0,321
	1,41	10,3	75,9	0,826
	2,35	16,7	66,2	0,766
	1,15	5,3	73,9	0,797
	2,18	24,8	78,2	0,943
	6,73	63,7	68,2	0,754
	1,92	4,7	53	0,482
	2,06	6,1	79,9	0,881
	1,22	4,2	6,1	0,902
			78,8	

Comparative study of the characteristics of the population in a typical 2010's school workbook (Geogenie 4, editor De Boeck 2013).

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Research statistics & education

"Data don't make any sense,
we will have to resort to statistics."

http://www.vadlo.com

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Little research

- **statistical education**: mainly methodological discipline - exists not for itself but **rather to offer to other fields of study a coherent set of ideas and tools** of dealing with quantitative information
(Cobb and Moore, 1997).
- **integration of statistics implies a basic quantitative literacy and the acquisition of a set of quantitative skills**
(Batanero and Díaz, 2010)

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Little research

- **Teachers' own statistical literacy** determines quality
- Teachers share a variety of difficulties and **misconceptions** with their students about fundamental statistical ideas and representations (Batanero and Diaz, 2010)
- Teachers have **difficulty in implementing an experimental approach** or teaching through statistical investigations (Stohl, 2005).

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From teachers side ...

- feel students experience **greater difficulties in statistics** than other topics,
- **consider themselves not well prepared** to help their students face these difficulties.
- **traditional beliefs and a static view** of the way statistics can and should be used in class
- do **not consider new forms** of visualising statistical information **as part of curriculum courses**

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From students side ...

- **not many opportunity** to work with statistics / computer-based visualisations.

- many students **not able to mean meaning** from the data and information they are presented with.

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What is needed

- **Promote statistical literacy and statistical reasoning** by engaging teachers with real data and training, through project work, statistical investigations and problem-based learning (Arnold, 2008)
- **Essential to work with ICT**
  data is not just a series of numbers, they are numbers with a context, having investigative cycles, interrogative cycles, and characteristic dispositions (Wild and Pfannkuch, 1999).

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What is needed

Technological pedagogical content knowledge model (TPCK):

- teachers need
  - technology,
  - pedagogy
  - content knowledge skills

  (Koehler, 2008)

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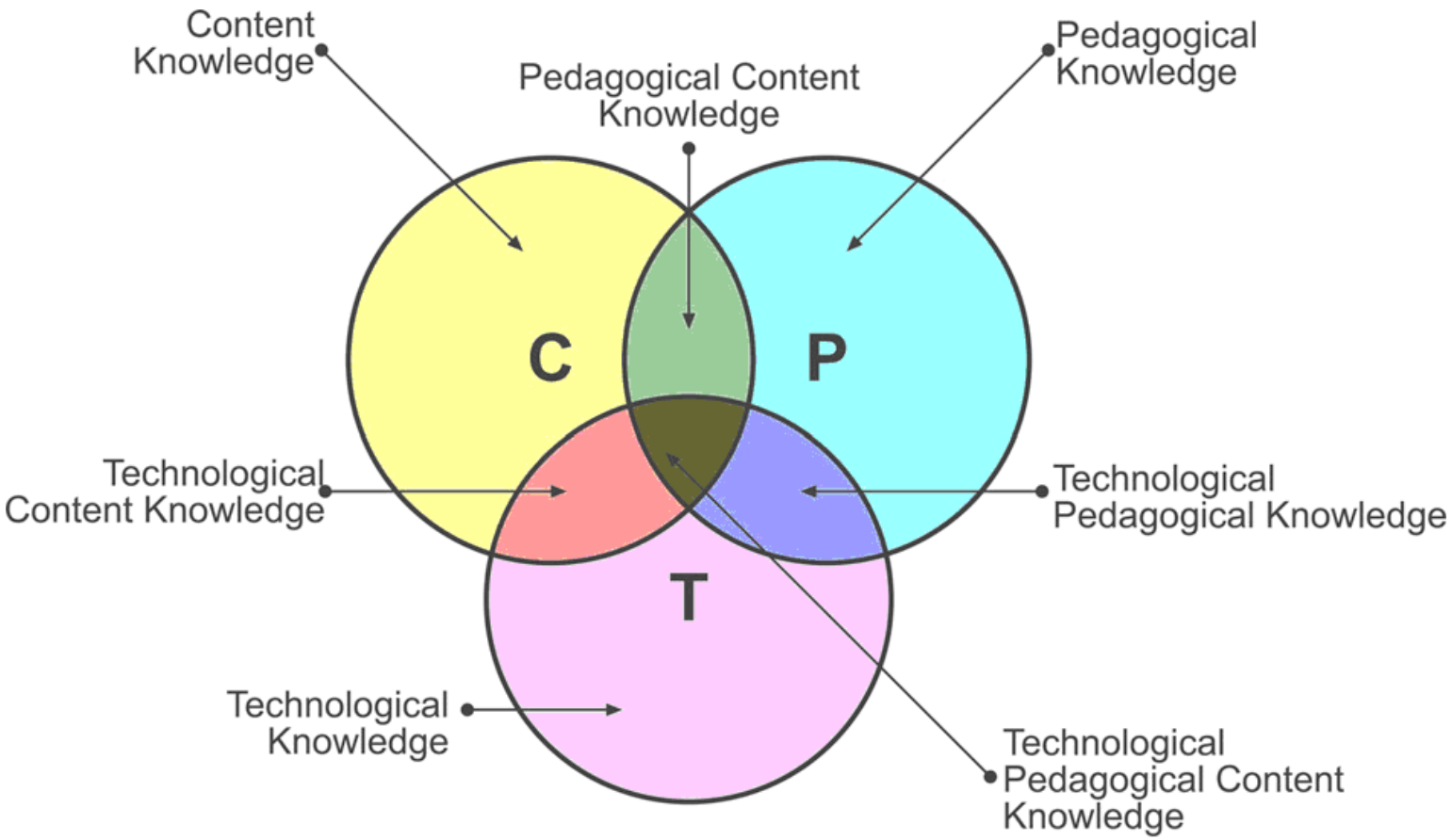
What is needed



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What is needed

Technological pedagogical content knowledge model (TPCK):

- teachers need
  - technology,
  - pedagogy
  - content knowledge skills

  (Koehler, 2008)

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The I-Use project

- a European funded project
- led by the geography department of Ghent University (Belgium)
- partners from Belgium, Bulgaria, the Czech Republic, Denmark, Greece, Sweden and the UK.
- outcomes: website, tools, teacher training course (TPCK)

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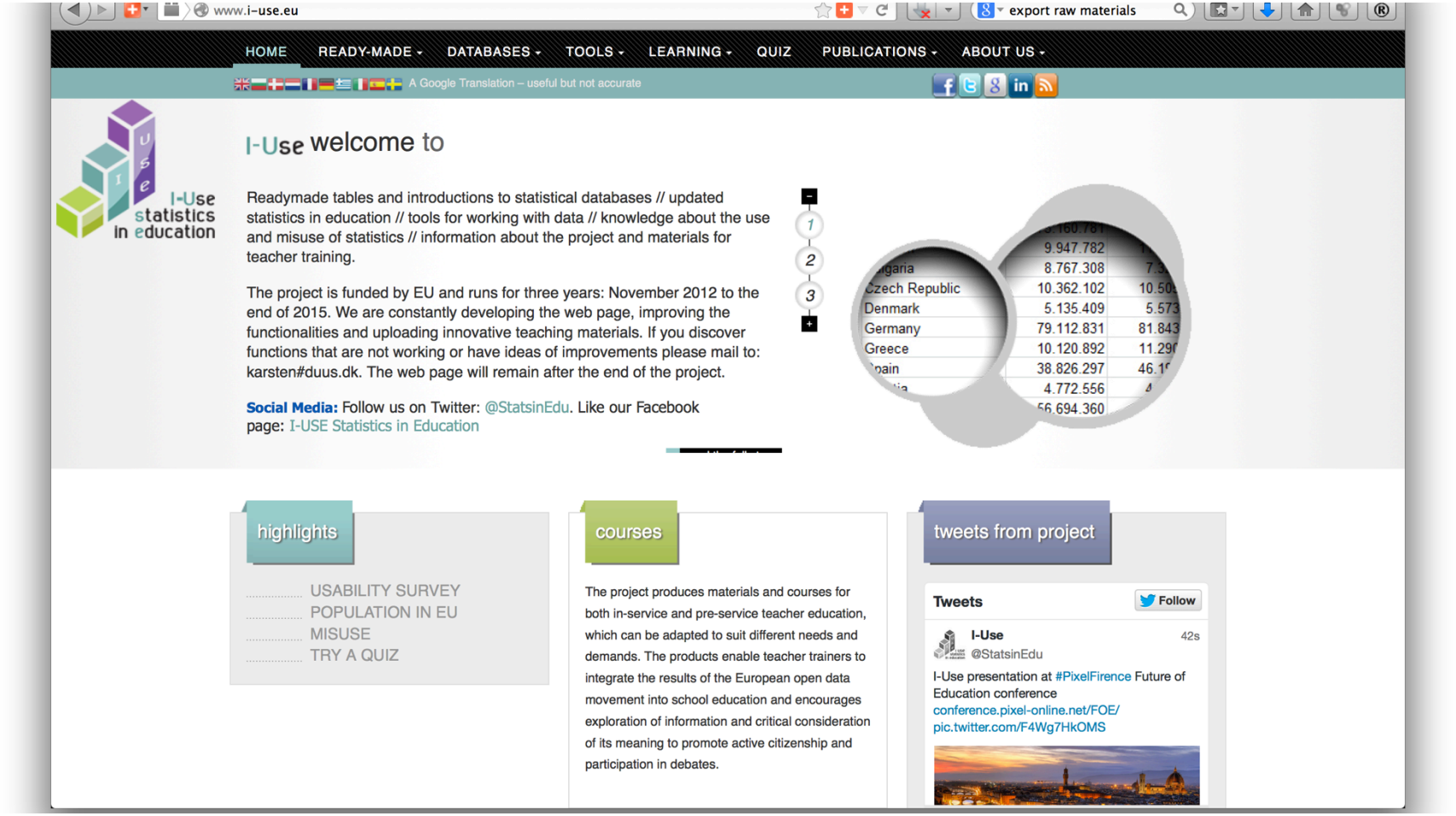
The I-Use project: website (T)



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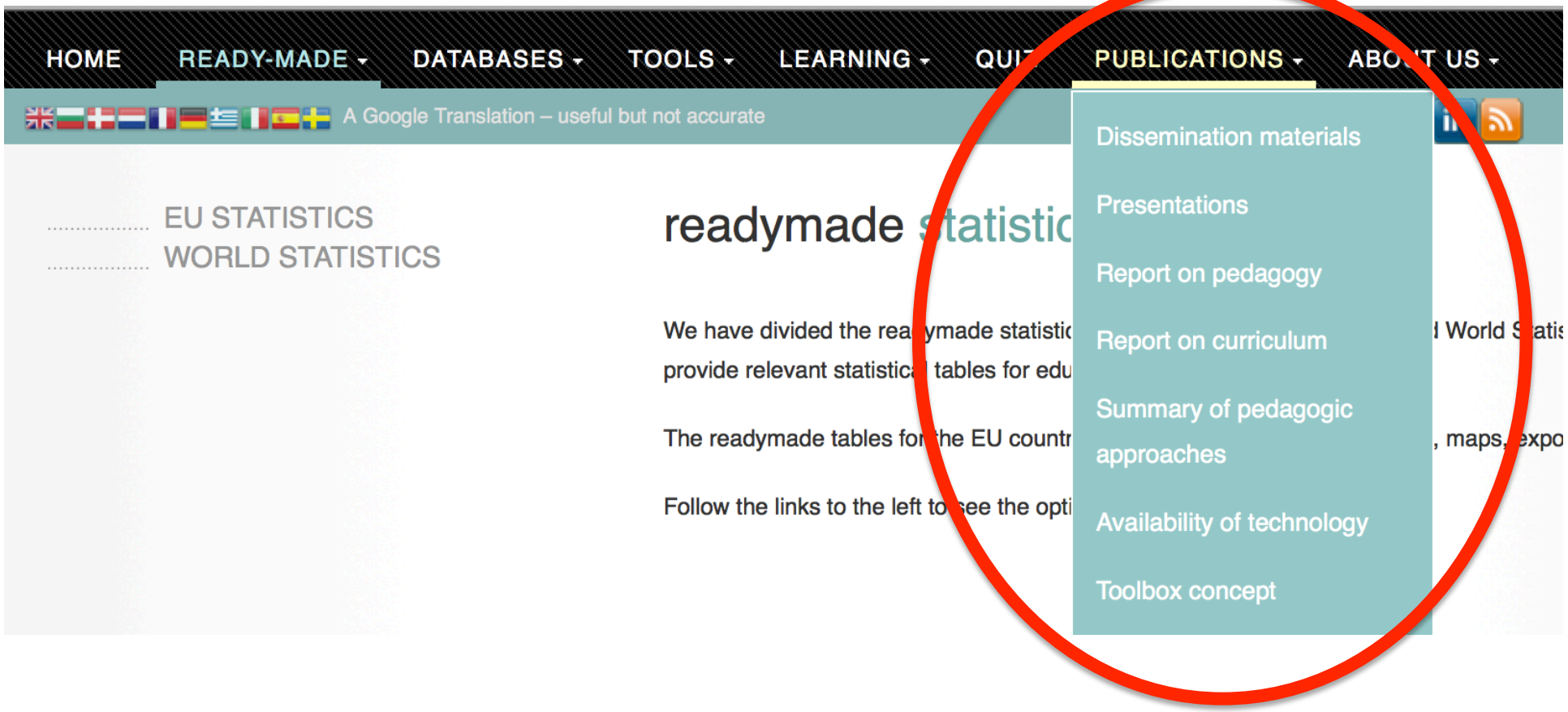
The I-Use project: website (T)



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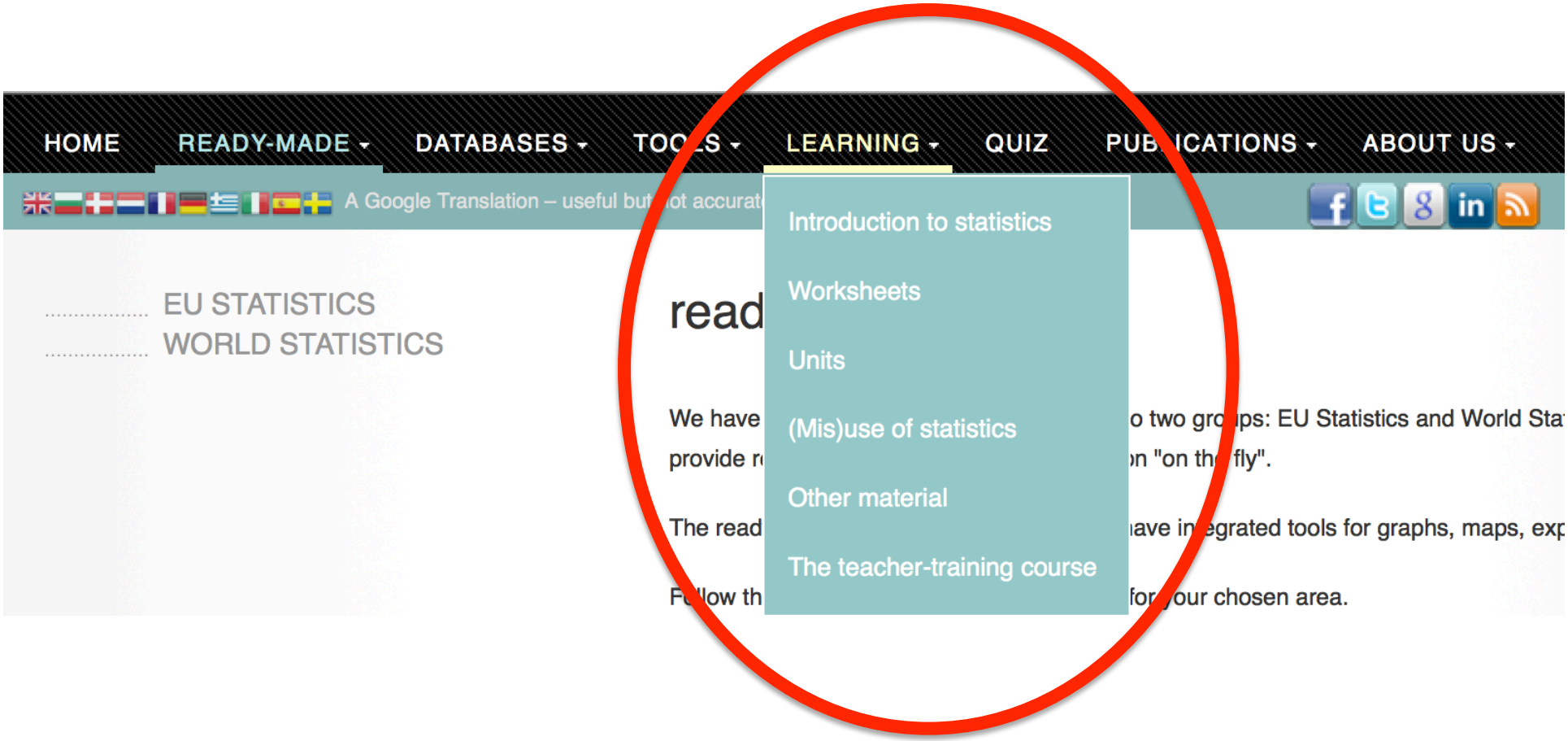
The I-Use project: website (C)



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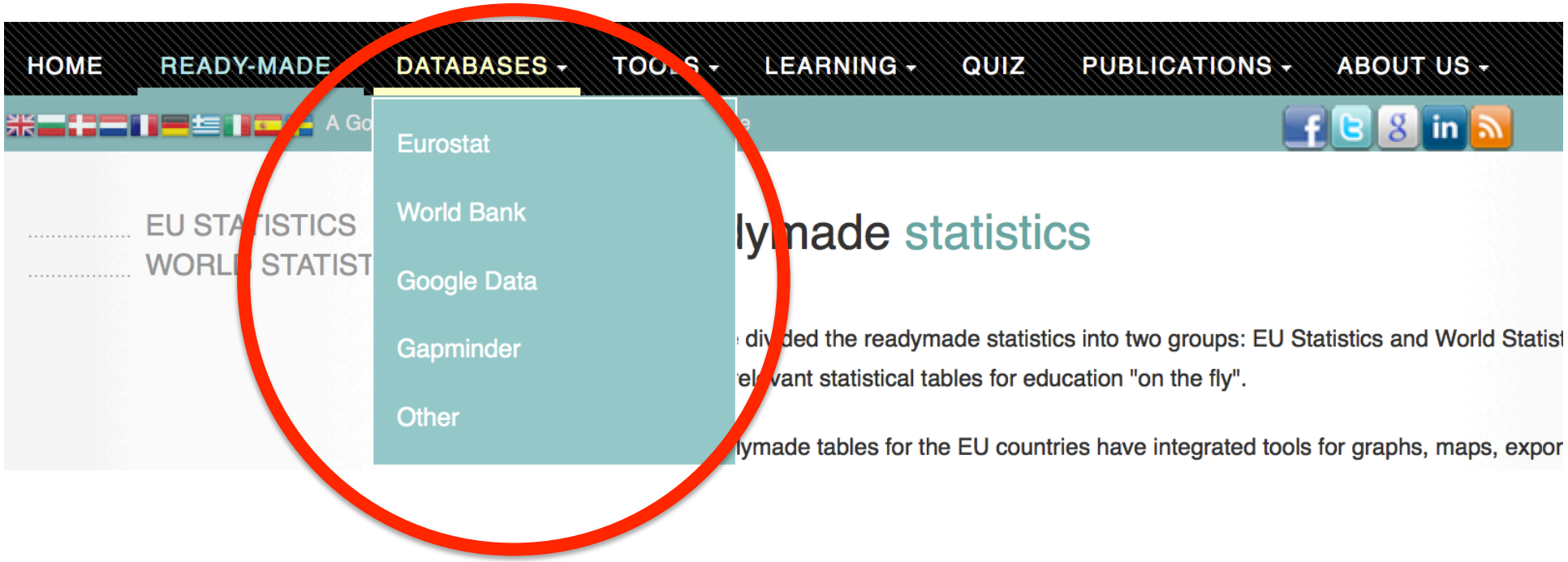
The I-Use project: website (C)



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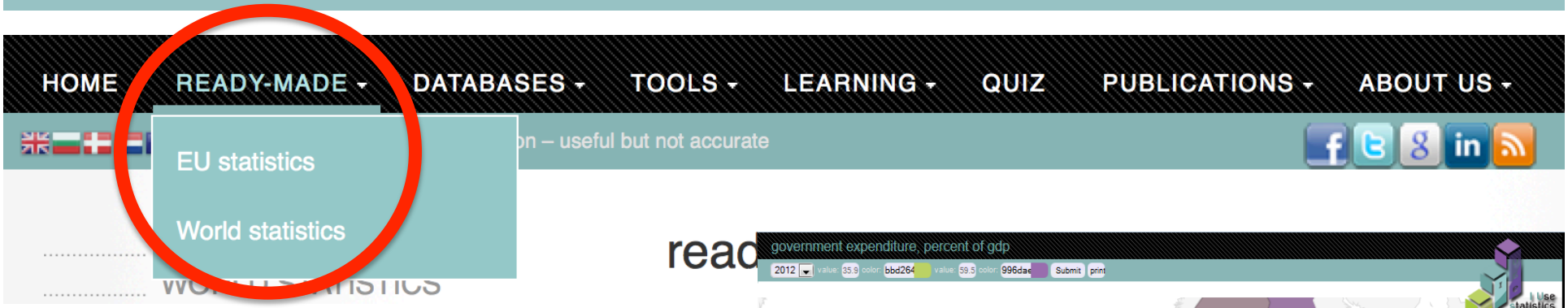
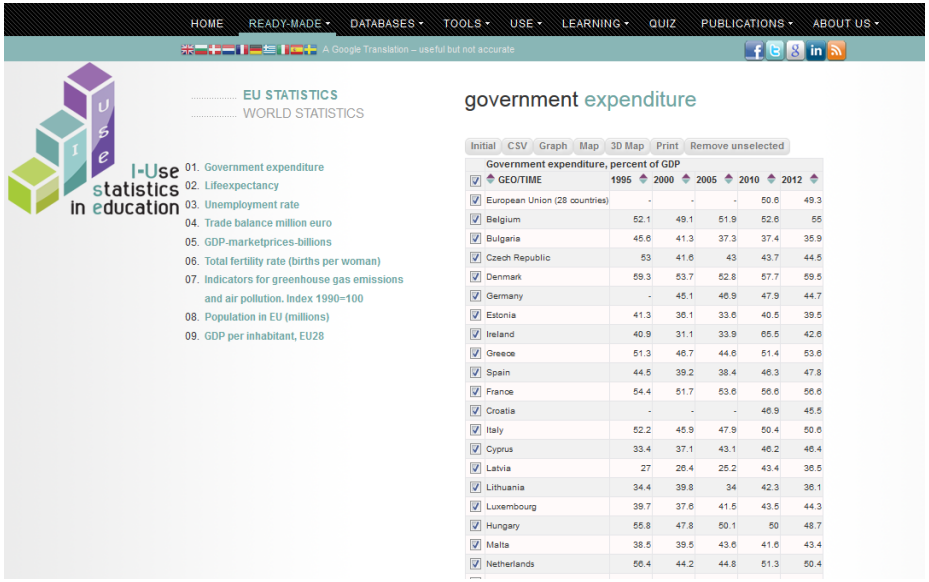
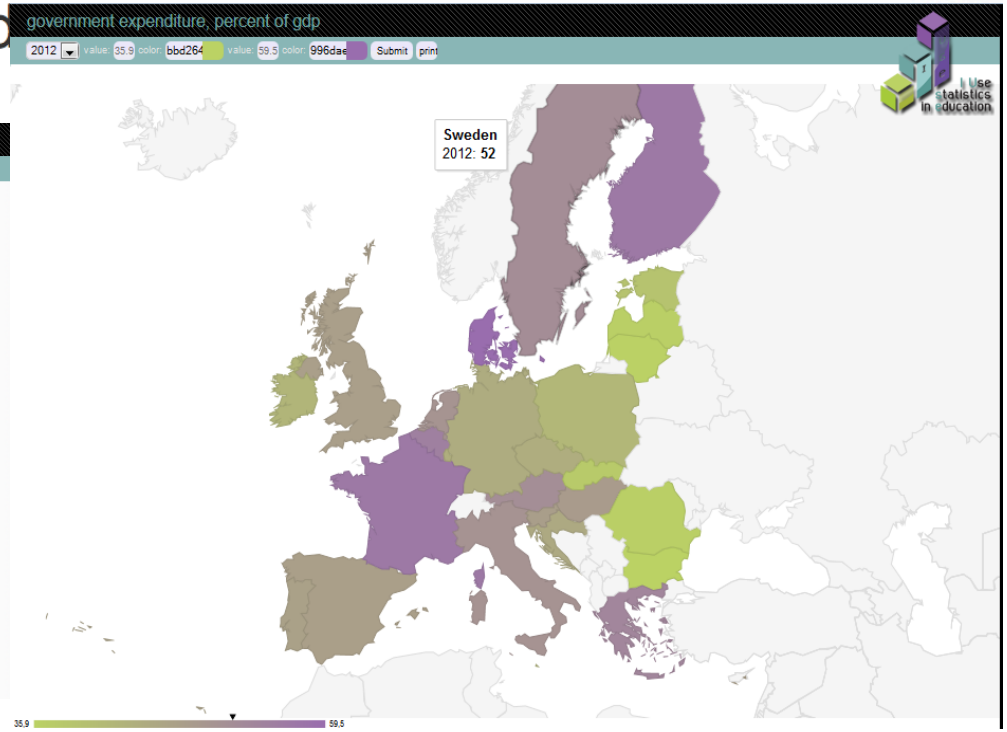
The I-Use project: website (T/C)





GEO/TIME	1995	2000	2005	2010	2012
European Union (28 countries)	-	-	-	50.6	49.3
Belgium	52.1	49.1	51.9	52.6	55
Bulgaria	45.6	41.3	37.3	37.4	35.9
Czech Republic	53	41.6	43	43.7	44.5
Denmark	59.3	53.7	52.8	57.7	59.5
Germany	-	45.1	46.9	47.9	44.7
Estonia	41.3	36.1	33.6	40.5	39.5
Ireland	40.9	31.1	33.9	65.5	42.6
Greece	51.3	46.7	44.6	51.4	53.6
Spain	44.5	39.2	38.4	46.3	47.8
France	54.4	51.7	53.6	56.6	56.6
Croatia	-	-	-	46.9	45.5
Italy	52.2	45.9	47.9	50.4	50.6
Cyprus	33.4	37.1	43.1	46.2	46.4
Latvia	27	26.4	25.2	43.4	36.5
Lithuania	34.4	39.8	34	42.3	36.1
Luxembourg	39.7	37.6	41.5	43.5	44.3
Hungary	55.8	47.8	50.1	50	48.7
Malta	38.5	39.5	43.6	41.6	43.4
Netherlands	56.4	44.2	44.8	51.3	50.4



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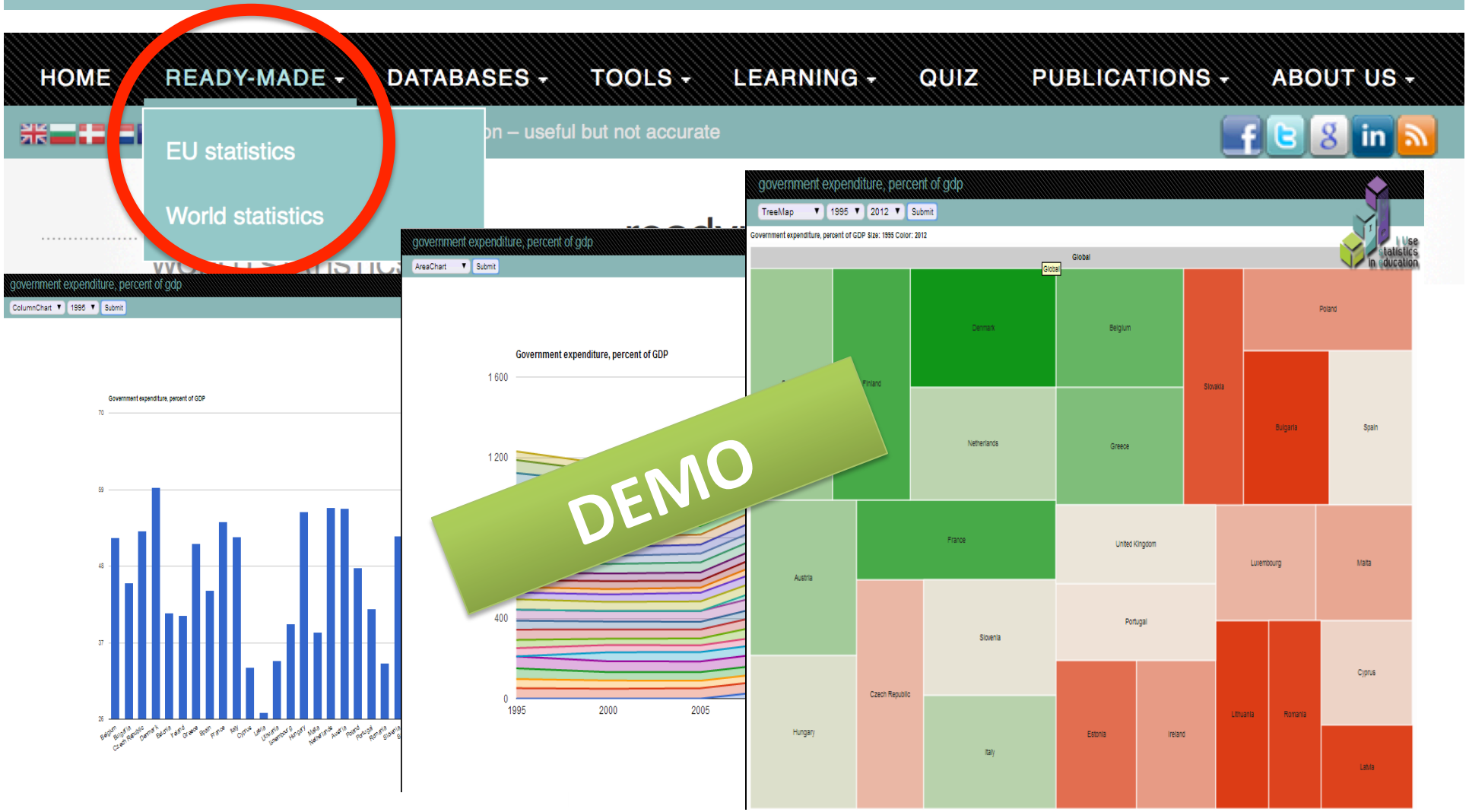
The I-Use project: website (T/C)



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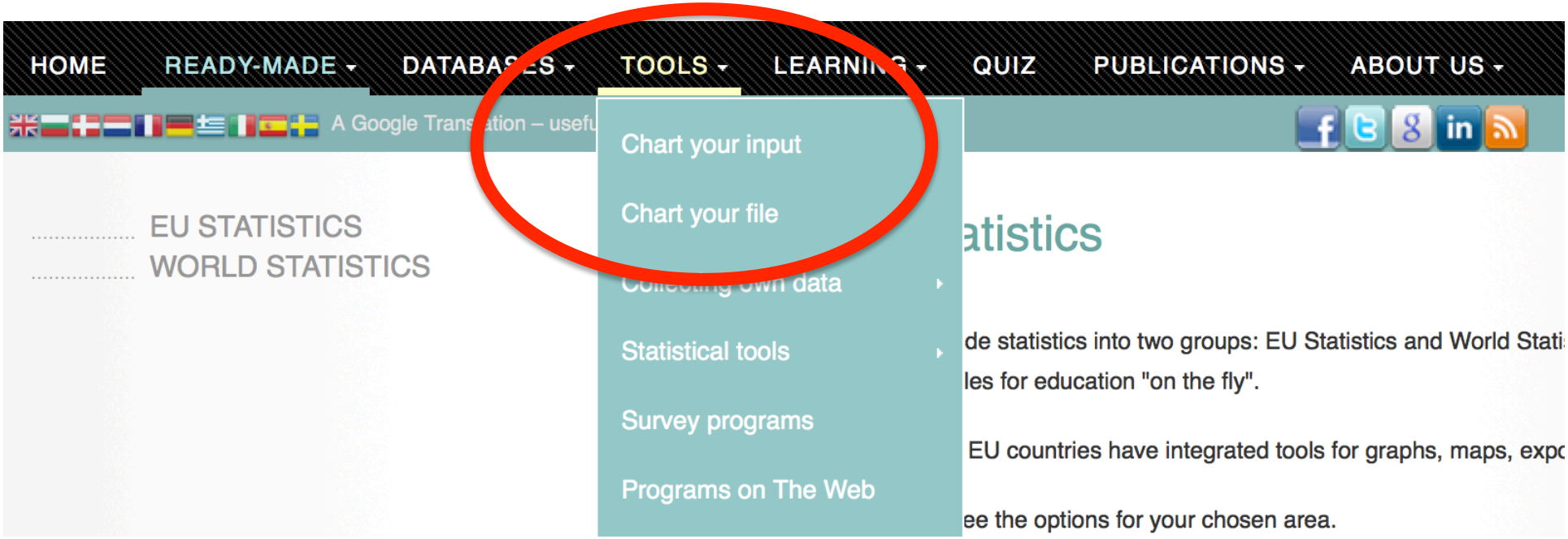

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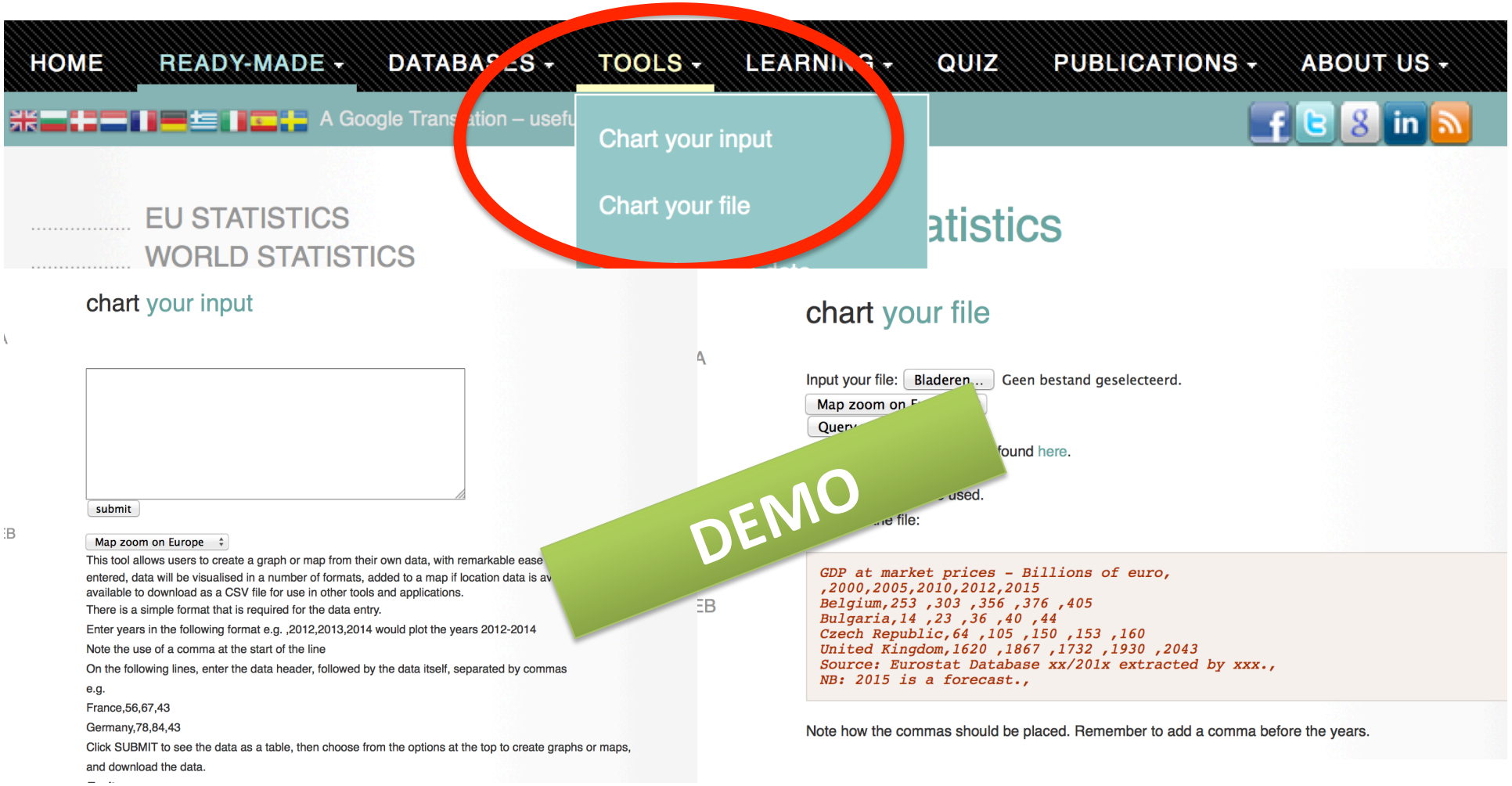

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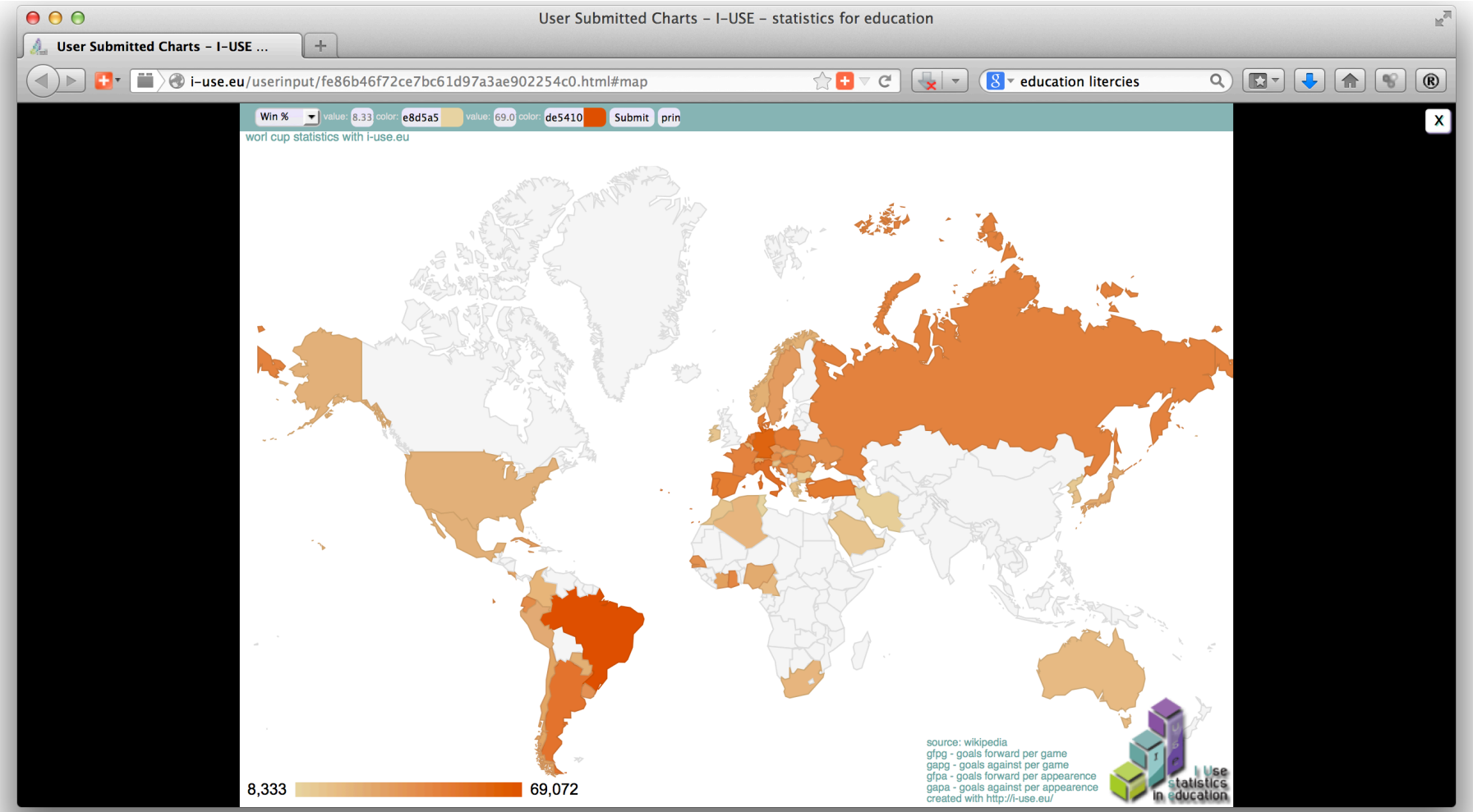

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The I-Use project: pedagogy – (P)

	settings.
Batanero and Diaz (2010)	Teachers have static view of the way that statistics can and should used in class
Roberts' Review (2002)	Shortage of statisticians in the workplace.

One of the implications of the problems summarised in Table 2 was a movement to socially – based curriculum frameworks and towards applications-based approaches to teaching students to think critically about social situations in which data are used, sometimes referred to as applying statistical literacy.

6 Review of recommendations and suggested strategies

If we want to improve the teaching of statistics we need to adopt changes implementing students to receive training that is both up-to-date and relevant for society's needs. Table 3 provides a list of some reform-based strategies and techniques, brief descriptions and examples of how they are used.

Table 3. Overview of Reform-Based Learning Strategies and Techniques (after Tishkovskaya and Lancaster, 2010; 2012)

Suggested Strategy	Examples of Use
Integrating schemes for assessment of statistical thinking and statistical literacy in to the curriculum (Gal, 2002; Schield, 2004; Watson, 1997)	Using media reports and newspapers articles to assess students' ability of interpretive statistical thinking.
Shifting the focus of statistics curricula from mathematical calculations to tasks of practical nature (Chance, 1997)	Students are given problems within different contexts so they exercise what they have learned in a variety of ways. Consider real world examples and applications.
Developing problem solving skills. (Garfield 1993; 1995; Marriott et al., 2009)	Implement problem-based learning strategies giving students open-ended problems and taking the role of 'facilitator' in the learning process. Use of real life examples in project work.
Developing strategies to motivate students (Garfield 1993; Watson, 1997)	Provide examples that have recently appeared in the media, government reports, news.
Developing statistical literacy and critical thinking skills. (Wallman, 1993; Gal, 2002, Schield, 2004, Arnold, 2008)	Include statistical literacy component in the statistical course. Focus on everyday arguments that use statistics as evidence

	Use examples of incorrect analyses.

Suggested Technique	Examples of Use
Collaborative learning. (Garfield, 1993; 1995)	Students work, together to solve problems or discuss concepts, sharing ideas and understanding. Collaborative group work with computers.
Active learning and introducing activities where students are able to construct knowledge. (Garfield, 1993)	Students are engaged in data collection, reflection on and exploration of statistical concepts, and solving problems on their own Small –group cooperative learning (as one of the ways for teachers to incorporate active learning)
Emphasis on exploration Pfannkuch and Ben Zvi, 2011)	Students posing their own questions, interrogating the data and learning new information about the real world (
Target misconceptions through discussion and assessment. (Chance, 1997; Garfield, 1995)	Instructions designed so that students will be encouraged to discuss their misconceptions. Introduce interactive assignments with feedback.
Developing the skill of communicating statistics (Schield, 2004)	Translate and present complex concepts into a format understandable to a wide audience. Ask students to explain terminology and to interpret the statistical results in everyday words
Use of TPCK model (Batanero et al., 2011;Lee, Hollebrands and Wilson, 2010)	Using a model of technological and pedagogical content knowledge that takes in account the statistical reasoning and concerns the pedagogical expertise for the effective engaging students in learning with technologies
Use of technology and on-line resources. (Garfield, 1995; Mills, 2002; Lee & Hollebrands, 2008)	Presentation of new material with the use of statistical software Simulation programs which allow students to explore statistical concepts in discovery-world environments Using useful resources available online.

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The I-Use project: pedagogy (P)

introduction:

- role and value of statistical information,
- visualisation and its use

4 modules on statistical literacy and quantitative thinking,

- examples of the use of statistics in different curriculum areas
- explicit reference to responsible citizenship,

online manual to help teachers to handle the materials and include them in curricula beyond the project.

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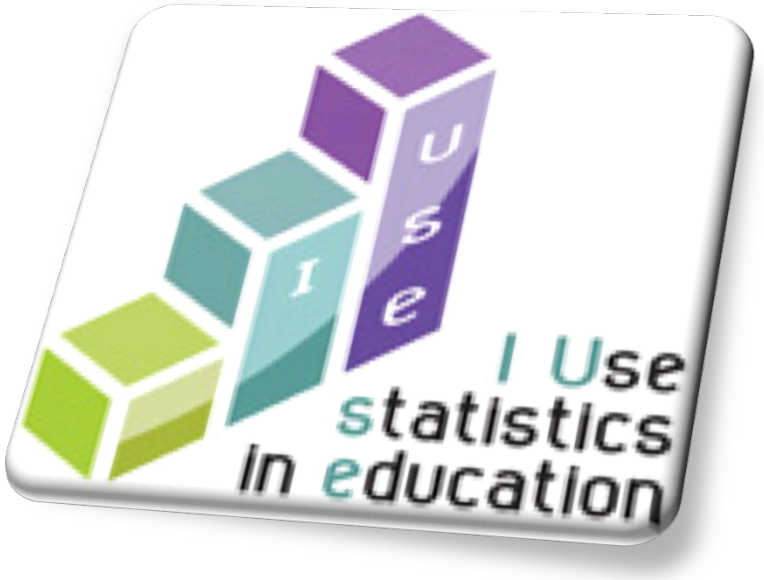
Next steps

- pilot course Mytilini
  September 2014

Erasmus + KA1

- Fina course, open as
  KA1 course
  7-11 September 2015
  Helsinge, Denmark



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Want more info

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