Teaching for virtual work

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Abstract – **Universities are still mainly preparing students for the world, where 'do something useful', i.e. 'do something with your hands' was the main principle and work was done during strictly regulated time. But world has changed and traditional areas of human activity (what also are the main target in University courses) are rapidly diminishing. More important have become virtual products - computer programs, mobile apps, social networks, new types of digital currencies, IOT (voice in your bathroom suggesting to buy the next model of Alexa), video games, interactive TV, virtual reality etc. Most of these new areas are not present in current curricula and there are problems with involving them in curricula - (working) students know (some aspects of) these areas better than many of university teachers, since corresponding knowledge is not yet present in textbooks – it is present only on Internet. The Internet strongly influences both what we teach and how we teach.**

I. INTRODUCTION

Nicholas Negroponte, founder and Chairman Emeritus of the Massachusetts Institute of Technology's Media Lab noticed already in 1995 that humanity is 'moving from a world of atoms to the world of bits' and replacing 'manipulating atoms with manipulating bits' – virtual things [1]. Manipulating atoms, physical things is left for automata and robots, we only create programs which rule these automata and robots.

Our values, the GDP (Gross Domestic Product, the measure of new values) produced in the whole world use less and less input from our natural environment, raw sources of nature - agriculture is producing only 5%, construction – 10%, manufacturing 15% of all values of the GDP produced in the World [2] and all these numbers are decreasing. The remaining 70% of GDP are produced inside human society itself, using as input data, generated also in human society – 2.5 quintillion bytes per day in 2017 [3].

The technology of production of new values – work – has also substantially changed. Work is not any more an activity, what we perform on defined times ('work hours') on defined location – workplace. More and more peoples work (sometimes not even recognizing this) all around the clock using laptops, mobile phones, tablets. Results of this work – information - goes to Negriponte's 'word of bits' and constantly accumulates there; information grows [4].

The 'world of bits' and its gods - Google, Facebook, Microsoft, Alibaba, Amazon – have become an essential part of our lives and their role is constantly increasing.

The irreversible move/encoding all our human environment into 'world of bits' has made this virtual world a very mighty power. Google, Facebook, Amazon know about us more and more and we do not even know, what all they know about us – it takes some (new) Snowden revelations to get even a glimpse of richness of all information stored about us in Google, Facebook, Amazon, Microsoft. And this 'Almighty God in Internet Clouds' does not forget anything; quite the opposite – every data item about us gets constantly distributed/sold.

Many teachers still think: "We teach. We present courses. A course is an interaction of teacher with students" – there is no or very little place for Internet in their teaching activities. Very wrong.

Here are considered some aspects of Internet influence in university teaching of IT specialty students. In the next chapter are considered economic reasons which create for many students need to work and become active self-learners using sources from Internet; then – the current rather confusing state of Internet and reasons for this; after that – more specifically state of JavaScript – the most important tool for designing web-based commerce and content delivery services and finally some techniques in course design and delivery which have been used and have been useful in practice.

II. WORK AND INCOME

We (teachers) are just a part (diminishing) of all interactions what students constantly get. Students who do have not (very) rich parents have to work, since ability of their parents to support their studies in university is increasing. The percentage of money returned from production process as wages is diminishing [5] and returns from capital are increasing, since the production is increasingly using more effective technologies.
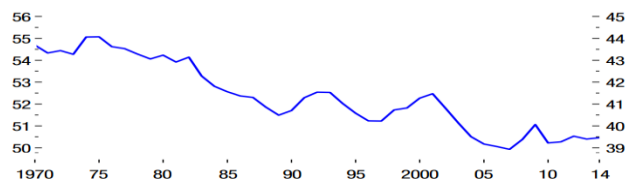

Figure 1.   The labor share of income (wages) from production in economically advanced countries (% on left) and developing countries (on right) [5]

As a result the average income of working families have stayed flat or are falling [6]; the centuries-long dream 'our children will have better life' is not true anymore.
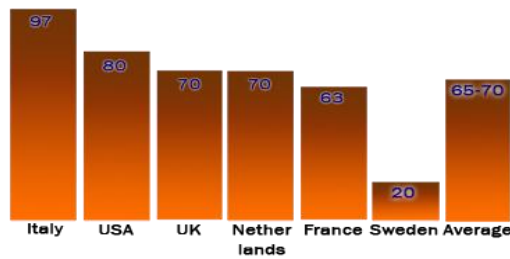
Figure 2. Percentage of population with flat or falling incomes in 25 advanced countries, 2005− 2014 [6]

Decrease of human labor share in production with increase of all kind of automata and robots is constantly eliminating professions. Universities with their slowly changing curricula develop skills, what are not corresponding to the skills needed by enterprises, thus their degrees do not a guarantee a getting a job or better salary. Constant pressure to increase the output (number of degrees/year) has gradually lowered the quality of those degrees [7]. At the same time number of alternative, free or low-cost learning opportunities is growing.

All this has decreased the value of higher education and researches claim, that our faith in the value of university education is not based on facts. Bryan Caplan, professor of economics at George Mason University (ranked as one of the highest research institutions in USA [8], the faculty have twice won the Nobel Memorial Prize in Economics) claims in his recent book "The Case against Education Why the Education System Is a Waste of Time and Money" [9], that education is grossly overrated, government should sharply cut education funding to curb this wasteful rat race and wasting public funds on education should be stopped. He is not alone, in USA percentage of confidents in higher education has dropped from 57% in 2015 to 48% in 2018 [10]. They may be right, e.g. when all your money-handling happens by clicking on screen or (diminishing) tapping your cards security codes, then why should you know how much is 2×2 ? If you really have to (diminishing probability), then take your mobile phone and ask the mighty source of all knowledge - Google. Information is constantly concentrating into greater and greater lumps [4] which all claim, that lower-level entities do not need to know all.

All these trends have supported increase of participation of students in work especially in specialties, which drive economy most - Science, Technology, Engineering and Mathematics (STEM), especially among students in Information-Communication Technology (ICT, IT) specialties [11]. From the survey made among EU students in 2018 [12] appears, that an average Estonian student works more than 30 hours per week; 48% explain this with economic reasons, but 72% claim that they need experience of work life (they want to learn); IT students (full) employment is over 80%.

Working IT-specialty students are active self-learners. From the Developer Survey [13] made at the end of 2018 by one of the most professional and popular IT sites 'StackOverflow' (over 80% of respondents rely on Stack Overflow Q&A when learning something) appears that three-fourths of professional developers have a bachelor's degree or higher, but almost 90% of developers stated, that they taught yourself a new language, framework or tool outside their formal education. New technologies/ideas in IT appear in much quicker temp than what it is in universities curricula.

A self-learning (working) student is not any more a 'tabula rasa' – a 'white paper' where teacher knows (or believes to know) what to teach. Working IT-specialty students have often deeply rooted habits and believes concerning IT technologies and their knowledge in some areas is superior to teachers. Adjusting university education with their previous knowledge is a problem [14] and with large part of their time devoted to work they have less time and interest for university. The professional knowledge they get from workplace and from Internet.

III. INTERNET

Learning has (the same way as work) become an all-time activity and with current Internet penetration and tools (mobile phones, tablets) this has become possible nearly everywhere (Internet is 'always on'), thus also more and more students are exercising learning nearly everywhere – at bus-stop, in bus, in a coffee-house, waiting for a girl/boy-friend etc.

Internet is not anymore the 'pure source of information' what it was intended when created. A growing part of Internet is driven by mighty force – "Make More MONEY!".

The first and simplest resource of money-making from www-page visitors is the Google AdWords – create account with Google, get some adds from Google, place them on your page/site and from every click on those you earn something – and (most important) Google as the broker earns also. Everyone wants to maximize the number of clicks and this has created a whole new 'Internet Science' – the Search Engine Optimization (SEO) [15] - how to move your page up in Google search results to have more potential clickers. From the first primitive technologies (add long list of keywords and build links to your site/pages in order to show it more significant) has emerged a new dark science employing multimedia (sound/video), entertainment (ea. images/videos, games on site) psychology (links to the social media, 'like'-s, 'Share', 'Follow') [16] have emerged businesses for selling clicks, from primitive click-farms [17] to modern services selling 'like'-s, followers and views [18]; e.g. for $35 you can buy for your site 25000 unique visitors from 60+ countries [19]. Every click has a value, it increases the rank of the site in Google search results – and this increases possibilities for more money. To achieve the ultimate target – make site visitor a paying customer – sites try to keep visitor's attention with content - distributing news items copied/steeled from other sites or simply creating 'fake news' using the latest AI (Artificial Intelligence), which can create stories which are undistinguishable from what humans can create (and not only in English) [20]; the open source program is already dangerous – it can be used e.g. for massive spam attacks, thus authors removed the most advanced version [21].

Current state of Internet resembles from history the era of conquerors - Genghis-Khan, Timur, Europeans establishing colonies etc, who rushed wherever they could

to conquer new lands and raw materials – gold, spices. Modern global companies are seeking modern raw material – data. The parallel with history creates question – will the current conquerors area in Internet end the same way – nations/countries rise to defend their territory, their data? Something along the way is already happening – the proposed EU Copyright Reform which may introduce upload filters and force new forms of copyright and data mining will substantially influence the use of internet. The already introduced rules (e.g. each cite asks for permission to store cookies) are only annoying and mostly nonsense – just answer 'No' or (if this answer is hidden in deep hierarchy of clicks) click in browser's menu 'Clear History' – all these cookies are also history, thus the current (mild) regulations do not work. Russia and some major internet providers are planning to test disconnecting the country from the internet [22]; China and several other countries have restricted Internet for years [23].

A site is interesting only if it has interesting content, thus many sites (Facebook, Google etc.) allow and expect users to add new content (blogs, comments), content is steeled (you may find from Google search the same text from several sites and often it is impossible to say, who was the original author). Internet dilutes information, it acts like the Second Law of thermodynamics.

We need constantly new information. On Internet stories are repeated and often slightly altered (to hide the original source), so that the 50th alteration may already look very different and be quite far from truth. But it is usually impossible to check, thus more and more people believe whatever. And even notice somewhere on www-page "Nothing On This Page Is Real" does not stop hundreds of people believe and create new, even more crazy stories [24]. President Trump stated in his book "The Art of the Deal" [25]: "People want to believe something is the biggest and the greatest and the most spectacular." Trump calls this kind of statements "little hyperbole" and "a very effective form of promotion" which "never hurts", but in Internet practices these "little hyperboles" are often total lies, but many people believe. Humans need new information, but Internet seems to destroy in many internet users the critical thinking ability what with profusion of content on Internet is extremely required. Humans have built-in need to get new information and for many the Internet has become the main source for satisfying this need. Neuroscientists claim that about 85% of humans are conformists, they 'go with flow' [26], [27]. The non-conformists become isolated, already Nikola Tesla noticed: "Anti-social behavior is a trait of intelligence in the world full of conformists".

Thus beliefs and opinions of growing number of people are driven by Pavlovian response to social media "like"-s. This concerns not only everyday stories, but also texts which are seemingly educational or (half) scientific [28], [29]. Because of openness of Internet many of those problems get corrected, e.g. problems with some articles in Wikipedia [30] have been afterwards several times and by several authors corrected [31], [32], but with many self-appointed specialists e.g. in programming technologies this is not so, the impact of diluted/fake information is quite strong also in sites concerned with science and technology, especially with programming

technology, where new methods/protocols/tools are distributed just on WWW.

IV. SCIENCE ON INTERNET

Every university teacher knows the universal pressure: 'publish or perish' university teachers are expected regularly publish articles in your specialty journals or (at least) conference papers. In most countries assessment of university teachers and researchers is based on Hirsch h-index [33], which should show your impact in humanity's development. But this is also a commercial product, thus - buyable [34].

Sometimes you do not have enough time for preparing an article or you simply do not have anything (new) to say – everything has been already said. But you still have to produce something, even if the quality of what you produce is not high. Thus there have appeared 'scientific publishers', who take your text to be published in an 'international web-journal' using 'rigid peer review' for a rather low fee from author (amount depends on author's country); the paper 'will be reviewed within 5-7 days' but publishing is promised already after 2 days; the published papers are mostly total garbage.

Number of 'scientific' conferences is growing in exponential rate. For instance, only one organizer announces for every month in 2019 that in Tallinn will be held 9—11 conferences, e.g. in March 2019 – nine conferences (but there are also many other organizers):

14th IASTEM - 569th International Conference on Social Science and Humanities (ICSSH) - Tallinn , Estonia

14th IASTEM - 569th International Conference on Medical, Biological and Pharmaceutical Sciences (ICMBPS) - Tallinn , Estonia

14th IASTEM- 570th International Conference on Environment and Natural Science (ICENS) - Tallinn , Estonia

14th IASTEM - 510th International Conference on Control, Automation, Robotics and Vision Engineering(ICCARVE) - Tallinn , Estonia

14th IASTEM - 569th International Conference on Science Technology and Management (ICSTM) - Tallinn , Estonia

14th IASTEM - 567th International Conference on Recent Advances in Engineering and Technology (ICRAET) - Tallinn , Estonia

14th IASTEM- 567th International Conference on Mechanical and Aerospace Engineering (ICMAE) - Tallinn , Estonia

14th IASTEM - 566th International Conference on Economics and Business Management (ICEBM) - Tallinn , Estonia

14th IASTEM - 567th International Conference on Civil and Architectural Engineering (ICCAE) - Tallinn , Estonia

Conference proceedings from the same organizer have extremely efficient publisher, e.g. the 5 papers in a conference held on Dec 28, 2018 have already all together 100 citations [35] – the h-index of authors grow rapidly.

Number of 'scientific on-line journals', 'wikis', blogs etc. is growing and it is very difficult for students (often also for teachers) to understand what is information, what just company advertisement and what – 'fake news', created with hope to get some traffic to web-site or, simply to satisfy authors need for self-importance.

The intellectual quality of many www-pages is (very) low. It is impossible to argue with claims: "is a self-

evidently poor choice", "is great" etc. [36], but most of assessments of programming technologies are made using such totally subjective claims which do not provide any supporting facts.

V. JOBS IN INTERNET ERA

Nowadays many students are not certain in their selected profession – old professions vanish constantly and sometimes very quickly. Even PhD diploma can not secure job; a PhD student confessed that job recruiter suggested to remove the notion of PhD diploma from his resume – this would make getting a job easier.

To have a glimpse – what is (currently) important, promising (good-playing) jobs, we checked some open work positions around the EU on Feb 2, 2019.

The IT-specific jobs in EU area [37] show several areas with growing demand:

security – 615326 offerings (e.g. for databases – only 572910); world's largest IT security organization The International Information System Security Certification Consortium (ISC)² states in their reacent study that worldwide need for cybersecurity professionals is close to 3 million [38];

entertainment: games – 526926, video – 518475, graphics – 515216, Virtual Reality - 510019 open positions;

AI - 508031; usually AI is considered for data analyses, but digital media specialists believe that the next big thing in interactive media is AI storytelling [39].

Students follow this kind of sites constantly, but advertisements for available jobs are for them only one source of interesting and important information what they follow to shape their live. The types of interesting and profitable jobs appear/disappear in IT rapidly.

An example: rapid changes in structure of Finnish economy is well seen from the last year's published personal income tax reports. The 'classical' powerhouses of Finnish economy are paper and metallurgy, but in the 2017 five from the top ten Finns with highest income tax were from the mobile game company Supercell, the company manager's personal income tax was 28 million € [40].

Games are the new literature of the 'Internet generation'. Authors of modern games use all the richness of book-era theoretical research up to Kant's theory of the sublime [41] in order to overwhelm players, create the full palette of human emotions from fear to ecstasy [42]. Arousing our emotions is the highest target of all arts what games are also approaching. The same target has been set by interactive streaming video, where users can decide in TV show, what happens next [43]. Augmented Reality (AR) and Virtual Reality (VR) market is expected to grow in five years 2017-2022 ten times [44] and number of users is doubling yearly. We all will get our emotions from virtual world.

The gaming (VR/AR/...) industry is huge, growing rapidly and together with constantly increasing bandwidth (bits/sec moving in your home Internet connection) provides many new ways for people to enjoy in home their favorite games.

Virtual world is already an essential part of younger generation and this shows not only from constant peeking of mobile phones. Many young people (students) make living playing computer games (in competitions), producing YouTube videos or publishing on social networks. Prize pools in video game tournaments exceeded 25 million USD in 2017 [45]. Best players have earned over $4,000,000 prize money; e.g. a 28 years old Estonian gamer has won from 106 tournaments total prize money $2,103,245.83 [46].

The International Olympic Committee (IOC) declared in 2017 that eSport (competitive video gaming) could be considered a sporting activity; in Singapore was launched eSport Academy; eSport market is growing 40% yearly, has multimillion-dollar prizes and international audiences, streaming game sites (Twitch [47]) have more viewers than CNN, Netflix and NBA finals.

Until the current Internet Era, skills and following incomes were part of one continuing person's development process – that's why we have schools and universities. These new possibilities 'to become rich quickly' clearly disrupt this tradition. Should these new skills be thought in universities and if, then who will teach them?

VI. EDUCATION IN INTERNET ERA

Connectedness and 'Information available at your fingertips' have changed the main premises of education. According to research, 35% of currently skills demanded for jobs across industries will change in 2-3 years and many of them will be obsolete in 5 years [48]. The average time in a single job is 4.2 years (in education, training, and library occupations - 5.1 years) [49], after that anyone should be ready for changes and re-learning, thus ability to learn constantly is the most important personal feature for success in our rapidly changing modern age.

It is difficult to give any receipt for developing learning ability – we usually assume, that this exists in everyone. However, there are some new approaches tried out for producing new IT professionals.

According to Douglas Adams, the "Answer to the Ultimate Question of Life, the Universe, and Everything", is the integer 42; the answer was calculated by an enormous supercomputer named Deep Thought over a period of 7.5 million years [50]. In the tuition-free computer programming school (Ecole) 42 which was opened in Paris in 2013 the main objective is not (only) in developing students technical competence, but developing students ability to solve and resolve problems, to collaborate, to learn and be able to inspect owns learning, self-teach, to be creative, to be critical thinkers [51] – the same targets which were stated in the EU framework for Education and Training [52].

The school 42 accepts students of any gender, religion, race, color and national or ethnic origin and provides to every student all the rights, privileges, programs and activities generally accorded or made available to

students. There are no regular classes, the learning room with networked computers is open 24/7. The school has campuses in Paris, in Silicon Valley and the model has been used also in Romania, South Africa, Ukraine, Bulgaria, Moldova, Belgium, Russia, Morocco, Netherlands and the Finnish game company Supercell announced that similar higher education level code school will start in 2019 also in Helsinki [53].

The school 42 is based on idea that the overwhelmingly important skill for future is programming (stressed everywhere) and the knowledge can no longer be transmitted in the classical teacher-student format, knowledge spreads in society and learning depends first of all from learner himself. Thus there are no teachers, students have to learn themselves, be resourceful and figure out how and what to learn. And since there are no teachers and traditional exams, grading is done by peer students and this is tougher than the traditional grading.

VII. PROBLEMS WITH SELF-LEARNING

The self-learning idea used in school 42 is quite similar to what working students (especially in new start-up enterprises) and also many other specialists (e.g. researchers and university teachers, who want to be aware of new developments in their field) use constantly. Since the school 42 is still rather new there aren't yet any solid data about the actual value of their method, but stressing in education only programming skills arouses suspicions on student's 'human' skills – communication, language – there are already many 'computer specialists' who can not express themselves in fluent written message (e.g. for asking pay-rise) in human languages.

The main difference of the school 42 method compared with self-learning working students seems to be in accenting the collaborative work –for all students there is one big classroom where students are supposed to interact and communicate.

But Internet has already changed the communication practices of 'digital natives' – many of them are not able to have a normal conversation or interacting with people in person [54], [55]. The first authors experience from his course on autumn term 2018 is similar – students do not communicate, they may sit hours next to each other and do not exchange a single word thus the advantages of this new form of education are not obvious. Experience got from teaching working students [14] show, that 'in wildness of Internet' appear 'fake news' also e.g. in propagating programming methods (just like in any other field) and without teacher's guidance this may cause not very good results and later re-learning, i.e. waste of learners time, as seen from the first author's experience in the course in browser game programming.

VIII. OUR EXPERIENCE

The main topic of the course are browser games using JavaScript together with advanced browser-programming technologies: 3D, sound and video in browsers, shaders and preparing games for mobile phones and tablets.

Browser is definitely the ultimate program in digital communication – if something visual appears on screen, then it is sent to you using the Internet communication protocol (IP) and rendered by a browser engine; most of the fixed-function apps in mobile phones also use browser rendering engines and Internet communication (in app the network side is striped – you can't switch to another site.) When Tim Berners-Lee created the World Wide Web (WWW) in 1989, the main idea was to enable scientists to exchange texts with their results. The WWW-documents were seen as pure ASCII text with minimal formatting based on the HTML format. Possibility to add images appeared only after several years, but even now the basis of a web-page and anything, what appears in browser, is HTML-formatted text which is denoted by its address, the URL (Unique Resource Locator). When user opens a web page (sends request with the pages URL), server responds with HTML-formatted text document – the web-page's text corresponding to URL. Server interprets this text and if the text contains links to images, videos, sounds etc. then browser sends new requests – a separate one for every image, video, sound. Browser can start page rendering – calculations where on screen should be displayed everything - only after he has received from server all page's components. On network it is impossible to say beforehand, when this happens. Thus to speed up page loading currently many www-documents consist of only one page (new information is displayed when you scroll downwards) and use one big image instead of many small ones – for every component is needed a new request.

The first HTML protocol did not have (except links) interactive elements. For interactivity was invented a new programming language – JavaScript, which was meant to be executed in users computer and therefore (for safety) very restricted, e.g. JavaScript did not have any access to user's hard disk (currently it has strongly limited access). The language was designed to be used also by no-programmers, thus it lacks many common features of typical programming languages (e.g. strong typing, modules, encapsulation etc.). But JavaScript is the only programming language for browsers and with human communication becoming more and more browser-based already in 2007 was stated a law: "any application that can be written in JavaScript, will eventually be written in JavaScript" [56].

Currently JavaScript is the main (only) front end, i.e. User Interface (UI) development tool. It is almost impossible to do something in modern web development without JavaScript – all interactivity is created with JavaScript.

The main activity on WWW comes from the 'big players' – Google, Facebook, Microsoft. Their web pages are quite complex with several frames, where user can enter data and connections with databases, where this data is stored. These 'big players' produce many web applications, but these pages are all repeating the same pattern, i.e. their programmers repeatedly produce many pages which are all similar, built from one model.

The 'big players' are also the biggest work providers in web programming, i.e. producing most www-pages/sites.

There are (on Jan 9, 2018) 218 Web browsers [57] – all with their differences/peculiarities. The major browsers

(Firefox, Google Chrome, Microsoft Edge – soon to be replaced with open-source Chromium) have their own JavaScript interpreters also with some differences; the JavaScript interpreters for browsers in mobile phones and tablets are also different.

In order to leverage JavaScript development for Microsoft browsers (Internet Explorer up to ver. 10), which did not follow web standards and were in many ways technologically outdated was introduced the jQuery library. Currently Microsoft browsers are already (somewhat) law-obedient thus jQuery is not any more needed [58] and its use is dropping rapidly:

Figure 3.   Use of jQuery in recent years (%, Google trends)

But jQuery is still growing like a cancer – the current version is already > 266 KB (for comparison – there is a competition for browser games < 13 KB [59] – some even 3D).

In order to automate mass production of web pages having similar format have the main players – Facebook, Google, Microsoft - introduced their own JavaScript packages and frameworks, which should speed up mass-production of pages and create pages which would appear on higher positions in search engine's (Google) results - SEO [60], thus Google is already determining the Internet programming technology. These packages and frameworks - Angular, React, Vue, Node etc turn on its head the original intension of Javascript – to be used as a lightweight simple tool for adding interactivity to web pages. These packages allow to create a web server and also allow to create the whole page as a Javascript text on server – thus it is easier to read for Google's crawlers. But this kind of use contradicts with long-time practice of browsers not to display any mistakes in order to make user's interaction with the page smooth and fluid. Any serious programmer would not use a programming environment where mistakes simply disappear.

But UI (User Interface) programming is the base of all web sites, thus one of the most popular jobs and students learn this since without knowledge of this it is rather difficult to apply for a job. Thus many of self-thought students consider these libraries as the whole JavaScript.

These libraries were developed for mass production of WWW documents with similar structure, thus they all use 'top-down' development methodology – first load some (currently popular) libraries, then step-wise elaborate. Repeated use of this methodology becomes also a thinking pattern.

Most programming tasks are different, e.g. the task in the game-programming course – to program your own game, where the 'load libraries' thinking pattern does not work anymore. For students were several step-by step tutorials with ended with working code (the tutorials were 'pure' JavaScript, no libraries). As the main development guideline was repeatedly stressed need to use minimal number of requests to server (basically only for a

spritesheet and soundclips), but it is difficult to break deeply rooted habits. Every year there have been some students who claim: ' in order to keep my mind I used all modern features...' – and fails to program a simple game. At their workplace they may be titled 'software specialist', but they cannot program – they can only load libraries. They have mastered tools, but not programming. Educational sources in Internet also teach tools rather than programming.

A browser game of one of participants using 'modern features' initiated 39 requests to server for loading modules – actually none were needed. His code contained total nonsense, definitions which were not used or objects, which were not defined, collision check of object with itself etc., there were described several levels with exactly the same functionality, difference was only in some object's shapes and colors, but author could (in second attempt) make only the first level working.

JavaScript seems to be the worst example of massively produced 'fake news' on WWW, and Node.js is the worst example of this. It is growing rapidly – every day are added 455 new modules [61], the total is now 800000 [62], but it seems that nobody checks the quality - you may upload 24252 useless lines of JavaScript [63] using for the same file two different names and get your name in the list of 2319 authors [64].

The Node.js is compared to mass psychosis [65]. It is (can be) highly inefficient – e.g. for three trivial functions `stripIndents`, `stripIndent`, `oneLine` (names are quite descriptive) are used 1826 files [66].

The Node.js library is created by developers free uploads, but it is practically impossible to restrict access or correct errors without paying - the website states "If you want to restrict access and visibility for a public package you own, you can make the package private", but before that "Making a package private requires a paid user account or Org" [67].

Its popularity is already declining, since many developers have (re-)discovered value of pure JavaScript [68]. :

Figure 4.   Popularity of node.js (%, Google trends)

IX. CHANGING TEACHING METHODS

The game programming course has had very inhomogeneous audience. The course is intended for second year students of software science specialty, but in every year there have been participants with very different background and preliminary skills: some have already published their games (also commercially, for money), some come from other specialties (e.g. mechatronics) seeking a second profession or simply from curiosity. Because of very different preliminary knowledge of students the classical 'stand-and-deliver' model of teaching does not work and instead of 'direct teaching' students

were provided an opportunity to learn from specially prepared tutorials.

The 'lectures-practicums' format was changed into one continuous 195 min session in computer class, where every participant was working alone with his/her networked computer (many students used their own laptops). The whole course consisted of series of practical hand-on tasks – participants had to implement an example game using code explanations provided in tutorial; for more advanced students tutorials had also further tasks/exercises. At the start (and when needed) are given some oral guidance, most of the time students implement the task using presented www-tutorial and help from www (googling) – nowadays students prefer googling to asking from a neighbor student or teacher.

Universities are increasingly trying to align with economy inviting representatives from business enterprises to give talks before students telling their experiences and needs - what kind of skills do they expect from graduates – e.g. for the spring semester 2019 are planned for students more than ten talks from representatives of Estonian enterprises; the Estonia's biggest telecommunication company Telia has organized for the teaching staff and PhD students a 40-hours course to acquaintance them with company's current technological practice and future directions; in the first author's game-programming course have given talks several participants of this course from earlier years who now have become successful game designers/produces.

University teacher's possibilities to change some practices of commercial enterprises are not very essential. But methods used in commercial enterprises are often influenced by not-so-sapient factors, i.e. desire to flatter Google in order to improve SEO or blindly follow general trends – 'everyone is using THIS, we should also'. The best method to fight these tendencies is to use student's common sense and creativity.

Many researches point for need to focus more on student's creativity and imagination instead of trying to teach skills. Martha Nussbaum, philosopher and the Distinguished Service Professor of Law and Ethics at the University of Chicago states [69] that in an increasingly uncertain world, it has never been more important for universities to "educate the imagination" rather than impart specific skills.

Imagination and critical thinking can be developed in conversation. The best moments were when some questions ignite a general discussion in the class, where students freely express their opinions and improve their critical thinking skills – the prejudices ('everyone does so!') are often shown mistaken already by fellow students without the need for interruption from teacher. And they may even accept some trivial truths – e.g. that the thicker the layer of (unknown/strange) modules (e.g. Node) the more difficult it is to get helpful error messages and even the most 'hard-boiled' users of the 'request' (command to load a module) may (half-)accept that with growing number of outside modules grows also the danger that something goes wrong because of changes in these modules – as it happened when just one developer broke

several popular JavaScript libraries (Node, Babel) and thousands of projects just with 11 lines of JavaScript [70].

X. CONCLUSIONS

The 'World of Bits' – Internet – has become an essential part of our lives. Especially noticeable is its influence on youth – our students. We all need information, students seek it actively and Internet is the greatest channel of information. But it differs from the classical distributors of news – it is focused on distribution and does not want to be responsible for the value of information what it distributes – it makes money on distribution, this allows to earn adding adverts to content. Mark Zuckerberg, creator of Facebook claimed before US Congress, that Facebook isn't a media company even though it hosts and produces content [71]. Traditional media companies - television, print and other media types have to follow strict regulations that make them responsible for the quality and truthfulness of their product. The textbooks what we use in teaching, their authors and publishers are also responsible for quality of their content. But it is nearly impossible to control quality and truthfulness of YouTube, where in every minute are uploaded 300 hours of video [72]; however, some students consider YouTube a useful source. Similar irresponsibility applies to many other Internet sources.

There are many very useful sources of knowledge on Internet, what we can and should use in teaching. But together with using this rich 'World of Bits' we also have to develop the critical thinking skills of our students so that they could themselves decide value of the 300 hours of new YouTube videos or 800000 Node.js packages.

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