Teacher Education in the Global Campus

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Introduction

Europe very clearly recognizes the role of the universities in building Europe of Knowledge. The main aim is to improve "*the performance and international attractiveness of Europe's higher education institutions and raise the overall quality of all levels of education and training in the EU, combining both excellence and equity, by promoting student mobility and trainees' mobility, and improve the employment situation of young people*"(http://ec.europa.eu/europe2020). The EU policy in education has three main objectives [30]:

- **improving quality and effectiveness** of education and training systems;
- **facilitating access of all** to education and training systems;
- **opening up education and training systems** to the wider world.

Another important measure is to open up universities to the outside world and increase their international attractiveness and thus - preparing them to a **broader international competition**, especially with the American universities which attract the best talents from all over the world.

New Technology Advances

The technology environment related to higher education is changing very fast, especially with the advent of the Web 2.0 technologies and cloud computing. The global education movement gave rise to another one, namely – **Open Educational Resources** (OER), which demonstrates great potential to overcome demographic, economic, and geographic educational boundaries and to promote life-long learning and personalised learning. According UNESCO, OER refers to **open provision of educational resources, enabled by ICT,** for consultation, use and adaptation by a community of users for non-commercial purposes [7]. A definition of OER is: "*digitised materials offered freely and openly for educators, students and self-learners to use and reuse for teaching, learning and research*" [29]. According to OECD, there are more than 3000 open access courses (opencourseware) currently available from over 300 universities worldwide. For instance:

- **MIT OpenCourseWare** (http://ocw.mit.edu) is the most popular example of institutional OER model - they published on the Web about 1,800 courses which are made available to educators and learners worldwide at no cost;
- **OpenLearn initiative** (http://openlearn.open.ac.uk/) launched by the UK Open University to make a selection of their materials available for free use by anyone and to build communities of learners and educators around the content using a range of tools and strategies;
- **OpenCourseWare Consortium** (http://www.ocwconsortium.org/) - a collaboration of hundreds of universities and associated organizations from around the world creating open educational content using a shared model.

A special case of OER are the **open textbooks** [10]. The cost of textbooks in higher education is usually paid directly by the students and their parents, and now it is a

substantial part of the total and rapidly increasing cost of higher education. A model of e-book based on the new technologies emerges: dynamic, interactive, regularly updated (including by users), localized, customized, remixed, etc. Open courses available on the web can also be a **center of communities of students and teachers.** These books and communities could be employed for **teacher professional development** in ways not possible or not easily attainable with static texts. The open textbooks, as well as the all OER movement, are very important instruments to approach the educational gap in the developing countries. The recent OER developments are related to **open repositories of research publications**, e.g. – Dspace at MIT (http://dspace.mit.edu/), DSpace of the TENCompetence project (http://www.tencompetence.org) and Sofia University (http://research.uni-sofia.bg/), Open Research Online of the UK Open University (http://oro.open.ac.uk/), TeLearn (http://telearn.noe-kaleidoscope.org/), etc. The Dspace at MIT Thesis collection, for instance, contains more than 20 000 items. Open access is critical to ensure fast and reliable access to EU-funded research results, in order to drive innovation, advance scientific discovery and support the development of a strong knowledgebased economy (http://cordis.europa.eu/fp7/ict/istag/). EU researchers, businesses and citizens can have free and open access to EU-funded research papers through OpenAIRE - Open Access Infrastructure for Research in Europe (http://www.openaire.eu/). OpenAIRE will provide a network of open repositories providing free online access to knowledge produced by scientists receiving grants from the Seventh Framework programme (FP7) and European Research Council (ERC). Such research e-infrastructures will open new avenues for research, education and innovation in Europe.

The **e-infrastructure** (cyberinfrastructure) is a **combination of hardware, software, services, personnel and organization**, which provides a wide range of services for the global research communities, such as [1]: high performance computation services; data, information and knowledge management services; observation, management and fabrication services; interfaces and visualization services; collaboration service. Such infrastructure would enable research communities and projects to rely on an effective application-specific, but interoperable, knowledge environments for research and education. New types of scientific organizations and supporting environments are emerging, e.g "*laboratories without walls*": **colaboratory**, **grid community**, **e-science community**, and **virtual community**. It is needed to "*enable, encourage, and accelerate this grass-roots revolution in ways that maximize common benefits, minimize redundant and ineffective investments, and avoid increasing barriers to interdisciplinary research*" [1].

The term e-infrastructure refers to a new research environment in which all researchers - whether working in the context of their home institutions or in national or multinational scientific initiatives - have shared access to unique or distributed scientific facilities (including data, instruments, computing and communications), regardless of their type and location in the world (http://cordis.europa.eu/fp7/ict/e-infrastructure/). Increasingly, new types of scientific organizations and supporting environments for science based on research communities are emerging and they can serve individuals, teams and organizations in ways that revolutionize the research practice. The e-infrastructure could be a platform for co-investments building new partnerships by universities and industry and thus – catalyze new organizational forms for knowledge creation and education in the digital age [1]. E-infrastructure and virtual organizations are enabling new form of learning: **learning through interactive visualizations and simulations** [28].

There are many examples of implementation of e-infrastructure projects, such as:

- The **Enabling Grids for E-sciencE** - EGEE (http://www.eu-egee.org/) project is funded by the EC and aims to build on recent advances in grid technology and develop a service grid infrastructure which is available to scientists 24 hours-a-day.

EGEE is the **largest multi-disciplinary grid infrastructure in the world**, which brings together more than 140 institutions to produce a reliable and scalable computing resource available to the European and global research community. At present, it consists of approximately 300 sites in 50 countries and gives its 10,000 users access to 80,000 CPU cores around-the-clock;

- **nanoHUB.org** was created by the NSF-funded Network for Computational Nanotechnology – NCN (http://nanohub.org). NCN is a **network of universities** with a vision to pioneer the development of nanotechnology from science to manufacturing through innovative theory, exploratory simulation, and novel cyberinfrastructure. Many students, staff, and faculty are developing the nanoHUB science gateway while making use of it in their own research and education. nanoHUB.org is designed to be **a resource to the entire nanotechnology discovery and learning community**. Computation and software is a cross-cutting theme that connects computer scientists and applied mathematicians to problem-driven scientists and engineers, to address large scale problems and develop community codes for nanotechnology.

The **vision of Europe** is that by 2030 a scientific e-infrastructure that supports seamless access, use, re-use, and trust of data will exist (http://cordis.europa.eu/fp7/ict/e-infrastructure/). The e-infrastructure allows the virtual research labs to become "*real*" – the researchers with different backgrounds could conduct global experiments remotely in real time and can collaborate on the same set of data from different perspectives.

The model of **Global Research Library** (GRL) is also emerging (www.grl2020.net). The fast development of the Web 2.0 technologies and the OER and e-infrastructure are driving changes in the library model as well. Several best practice cases are reported, e.g. in the area of Nanotechnology, Earth Sciences, High Energy Physics. The GRL of the future should be: multi-ethnic, multi-cultural and multi-lingual; a collaborative and global environment, which emphasises the ethical issues surrounding data; purposefully inclusive, attending to different cultures. Building pan-European e-libraries is among the main priorities of the EC. Such project is Europeana (http://www.europeana.eu).

Current and Emerging University Models

The university, as a center of teaching and research, is a genuinely European invention and the existence of the university was inspired by and confined to European cultural, economic, and political dominance for a long period of time [36]. Through the centuries the universities have changed considerably and they have also remained the central European institutions of reason, knowledge, criticism and learning [39].

A **virtual university** (**virtual campus**) can be seen as "*a metaphor for the electronic, teaching, learning and research environment created by the convergence of several relatively new technologies including, but not restricted to, the Internet, World Wide Web, computer mediated communication*" [38]. The notion of "*campus*" reflects the American traditions in higher education. Turner states: "*As a kind of city in microcosm, it (the campus) has been shaped by the desire to create an ideal community, and has often been a vehicle for expressing the utopian social vision of the American imagination. Above all, the campus reveals the power that a physical environment can possess as the embodiment of an institution's character"* [35]. Although many universities are not "*campus universities*", all of them might afford building their virtual campuses. In this respect it would be more appropriate to use the term "*virtual campus*".

Appart of competition between universities, a clear **need for cooperation** between them is of crucial importance. Many universities use the partnership as a means of entry into the global e-learning market and to penetrate less economically advanced countries [3]. The partner institutions from the less economically developed country bring adaptation to local

culture, language benefits, local or national accreditation, sharing of costs and risks, and access to neighbouring markets or markets with similar language and culture. Many countries have announced national virtual university initiatives of various kinds [7]. Some of these initiatives are intended to extend and enhance local provision while others are targeted at international markets.

The OECD *Global Student Mobility 2025* Report foresees that the demand for international education will increase from 1.8 million international students in 2000 to 7.2 million international students in 2025, which presents enormous opportunities and new challenges for all universities [29]. In nowadays knowledge intensive society, **research universities**, which are key institutions for social and economic development, are becoming more international in focus. A subset of research universities reflects a new phenomenon, defined as the **Emerging Global Model (EGM) of the 21st century research university** [21]. The emphasis here is on the international nature of a small group of institutions that represent the leading edge of higher education's embrace of the forces of globalization. EGM universities are engaged in **worldwide competition** for students, faculty, staff, and funding and they operate in an environment in which traditional political, linguistic, and access boundaries are increasingly loosing their traditional roles. Some call the EGM a "*super research university*" to emphasize the worldwide perspective and the high scholarly output of this subset of research universities [2]. The heart of the EGM is an expansion of the older functions of teaching, research, and service into an organization that can best be described as a **knowledge conglomerate** [2]. The professors in an EGM university have multiple responsibilities - they not only are expected to conduct research but also to teach graduate and undergraduate students, to provide service to their universities, and to use their knowledge for the benefit of local and national communities. In both developed and developing countries new relationship ("*triple-helix*") among higher education, industry, and government tend to be established and the third mission of the universities has been defined – to serve to the society [8]. The governments support research universities to collaborate with businesses to develop the economy.

Accreditation of the cross-border education is among the biggest issues in globalization of education, e.g. **how one can ensure that institutions will receive equal treatment** from the various accrediting bodies. It has been identified certain **risk of commercialisation** of quality assurance practices on an international scale. Some valuable **guidelines for quality assurance of trans-border education** are provided by OECD and UNESCO [29, 36].

The Global Campus Model

The Global Campus Model (GCM) is based on advanced ICTs and incorporates the main characteristics of the EGM and the features of the Research, Entrepreneurial, Electronic and Virtual University models [23, 24]. The GCM is intrinsically global since the ICTs provide natural means to cross borders. The GCM fits most to one of the following models of virtual universities, identified by Middlehurst [19], namely "*an evolution of an existing institution, with a unit or arm offering virtual education*", or "*a consortium of partners constituted to develop and/or offer virtual education*". The cases of "*a newly created institution operating as a virtual university*" and "*a commercial enterprise offering online education*" could fit in case of alliance of universities and other strategic partnerships.

The GCM adopts the assumption that the "*current educational reform is driven by three major factors - asynchronous space and time, responsive environments, and virtual reconstruction*" [18] and, instead of having "*a unit or arm offering virtual education",* the GCM follows the model of *Virtual Campus* as a **virtual reconstruction** of the existing campuses and "*bricks and mortal"* buildings, i.e to "*redesign and reconfigure the human experience of existing physical spaces without having to make physical, structural changes*

in buildings". Thus, virtual spaces would complement the physical spaces when designing an effective, student centered learning environment. A virtual campus will be a virtual learning environment that not only integrate a variety of software tools but also integrate all the physical tools that can be found in physical campus. We adopt also that the concept of *learning spaces* as one of the main features of the future learning [32]. The "*place-making*" is a very appropriate metaphor for designing cyberspace because *"the virtual places will include socio-cultural and perceptual qualities, enriching them to the point where they may approach - perhaps even surpass - comparable physical settings*" [13]. In such way even non-campus universities could build their virtual campuses and make the campus education not only a good American tradition [35] but rather a **world standard for global higher education**. Refering to this tradition, the *"Educating by Design"* principle [34] could be applied by transforming it to a **virtual campus design** principle. Strange and Banning provide a comprehensive model for creating student-friendly and learning-supportive campus environments and discuss **four conditions for successful learning**: promoting safety and inclusion, encouraging participation and involvement, building a community of learners and designing for education with campus assessment [34]. They focus on the many complexities of campus settings and how they contribute to student success and the quality of learning experiences. The institutional virtual campus could evolve into a **global virtual campus comprising all university branches and partner institutions**. A (global) virtual campus would be enourmously opened towards the other stakeholders and the users and provide *virtual places* where they could meet, cooperate, communicate, share information and knowledge. In order to meet this challenge, an GCM university could transform towards an University 2.0 model [24], incorporating the OER strategy, and use new tools for authoring, reading and collaborating on the emerging e-Books platforms[16]. The university could also benefit from the movement of creation of **e-libraries**.

As virtual organizations they will also incorporate new form of learning: **learning through interactive visualizations and simulations** [28]. The GCM universities are developing partnerships and they would have an opportunity to jointly build a (global) virtual campus and e-infrastructure in order to do e-science. One of the measures for global reach of a university is the percentage of foreign students, PhDs and postdocs. The GCM university could promote **virtual mobility schemes**, e.g by following the Virtual Erasmus model, which complements the existing Erasmus exchange programmes [31]. The virtual Erasmus can be used to prepare and follow-up the physical mobility or/and take courses at the home university while staying abroad. In addition, it embeds "*networked e-learning (in transnational collaboration of teachers and students) as an integrated part in mainstream higher education, aiming at transferability, scalability and sustainability: joint programme and course development, joint learning activities as virtual integrated elements of blended learning, 'following' (e.g. elective) courses abroad in a virtual mode*" [31]. These models could be further extended towards a combined Virtual/Physical Recrutement Model since the GCM universities are "*adopting worldwide recruitment strategies fo students, faculty, and administrators*" [21]. The model of virtual mobility would be very useful for developing countries in their efforts to reduce the **brain-drain and turn it into a brain-gain** status and thus - contribute to their home countries' national growth and helping to reduce the rising "*knowledge gap*" between them and the developed countries. In order to fulfill this mission, the GCM universities should closely cooperate with international non-governmental organizations and multi-governmental organizations, such as UNESCO.

The GCM universities should be **increasingly more research intensive** and able to apply scientific methods in disciplines outside the sciences in order to fulfill their third mission, i.e. for solving problems of global importance of the society as well as to have **strong orientation towards regional development and innovation, especially SMEs**. We

adopt the framework of actions for strengthening and extending the university research provided by Weiler [40], however they would be powered by the new GCM e-infrastructure.

The GCM is also "*an expansion of the older functions of teaching, research, and service into an organization that can best be described as a knowledge conglomerate*" [23]. Being a kind of "*knowledge intensive enterprise*", a GCM university needs an **effective knowledge management strategy** and this becomes one of its main characteristics. The knowledge management emerged as a result of the development of ICTs and the changes in the organizations' structure, functions and management practices all over the world. The globalization of educational markets and the global competition put the focus on effective management of intangible assets as a way universities to achieve competitive advantages since the knowledge is the essential asset of them. The professors in a GCM university will face fast increasing global competition, especially with the development of the mixed virtual/physical mode of mobility and recruitment. They will have multiple responsibilities, i.e. not only to conduct publishable research but also to teach graduate and undergraduate students, to provide service to their universities, and to use their knowledge for the benefit of global, local and national communities. The use of ICTs demands new skills and additional time for effective usage. The GCM universities will need a **future generations of research scientists and engineers** [23, 28] which are able to use tools and services of the e-infrastructure and apply new methods to observe and acquire data, to manipulate it, and to penetrate into new interdisciplinary areas of research.

"*Entrepreneurial*" is considered as a characteristic of the whole GCM university systems, i.e. the entire universities and their internal departments, research centers, faculties, and schools. This means that a GCM university should actively seek *"to innovate in how it goes about its business"* and *"substantial shift in organizational character in order to better perform in the future*". Such university should also "*understand the commercial value of knowledge*" and make capitalization of research findings one of its primary features [5].

Establishment of science parks, incubators and growing innovative businesses could be considered as another good American tradition which started with Stanford Research Park (1951) and the Cornell Business and Technology Park (1952). However, the GCM universities could use the power of the e-infrastructure and go towards **building virtual organizations** of such type as well [28]. A GCM university could adopt most of the characteristics of the Innovation University Model, e.g to become leading actors in the field of **continuing education and development services provided for working life** and to **increase intangible capital both inside the universities and through them in society** [17]. All this will shift relationships among universities and government, business, and society. A successful organizations (universities or enterprises) within the future e-learning market will adopt a learner (customer) oriented paradigm [12].

The so-called "*cloud computing*" concept emerged. It stands for: open information content, software and services; service orientation and delivery; service and storage virtualization; standardization of computing across [14]. On the way to a knowledge society in a dynamic ICT environment, the universities should catalyse a process of deep institutional change. One of the major challenges facing the universities in the next decade is to reinvent themselves as information organizations [37]. Unsworth emphasizes that the "*universities are, at their core, organizations that cultivate knowledge, seeking both to create knowledge and to preserve and convey knowledge, but they are remarkably inefficient and therefore ineffective in the way that they leverage their own information resources to advance that core activity*" [37]. The model of University 2.0 is a framework for universities to adapt to the social computing phenomena and to the networked information economy. University 2.0 can be described as a research and entrepreneurial university, which integrates Web 2.0 technologies and applications in all university activities, including ones with all knowledge intensive stakeholders [24]. A basic concept in bridging the university

and society is *Community of Practice* (CoP), which is defined as *"groups of people who share a concern, a set of problems, or a passion about a topic, and who deepen their knowledge and expertise in this area by interacting on an ongoing basis"* [41].

The GCM university organizational structure will follow the University 2.0 characteristics and will resemble the vision for "*Cloudy Academy*" [14]. A GCM university could also become a *virtual organization* (VO). A VO is "*a group of individuals whose members and resources may be dispersed geographically and institutionally, yet who function as a coherent unit through the use of e-infrastructure*" [6, 23]. Such VOs are for instance EGEE and nanoHUB.org. VOs include a broad range of operational options, e.g they can be formal or informal, planned or unplanned, transient or long lived.

Teacher Education in the Global Campus – Some Case Studies

The teachers are among the main actors that are involved in process of *school re-engineering* and the corresponding educational change. According to Fullan continuous development of all teachers and the school reform are interrelated [11]. He states that the educational change "*…involves learning to do something new, and interaction is the primary basis for social learning. New meanings, new behaviors, new skills and new beliefs depend significantly on whether teachers are working as isolated individuals or are exchanging ideas, support and positive feelings about their work".* Teachers must know the most current research and practice which can be used effectively to match particular teaching procedures to children with particular needs. Friedman has compiled a Web 2.0 Schools teachers oriented electronic book, which contains rich of expertise and experience papers of a number of leading-edge Web 2.0 in education practitioners [9]. He says: "*The web is, and always has been, an exciting place for education in terms of the possibilities it offers for research and collaboration. Now, it is even more exciting, with the appearance and development of new tools which have become collectively known as "Web 2.0*".

We can define the **Web 2.0 Schools** as *schools that use predominately Web 2.0 based educational applications and services in their educational activities* [25, 26]. The Web 2.0 virtual learning environments provide opportunities for students, teachers, parents and other stakeholders to contribute to creating useful and 24/7 available educational resources. Students can produce a new resource or edit existing ones for other students while they are learning themselves. Even the well-known PC applications, such as word processors and spreadsheets, come to a new life in the Web 2.0 world. A lot of Web 2.0 School oriented portals providing access to web services and content for educational purposes are emerging, such as: Schoolforge (http://www.schoolforge.org.uk), Edu 2.0 (http://www.edu20.org/), Change Agency (http://www.ed421.com/), Shambles: Education Project Asia (http://www.shambles.net/), Web 2.0 for the Classroom Teacher (http://www.kn.pacbell.com/wired/fil/pages/listweb20s.html), etc.

A Web Assignment Database (http://wad.fmi.uni-sofia.bg/wad/) was created in the frames of the multinational European project '*Innovative Didactics via Web Based Learning - IDWBL)*'. This is a database which provides opportunities for building a community of teachers. It helps them to communicate and to develop and retrieve web-based assignments for teaching and learning in several subject areas. Teachers and learners who are registered as users have access to a whole range of functionalities, such as: adapting assignments, allocating assignments to students, creating products, giving and receiving feedback on assignments developed by colleagues and rating learner's products.

A digital repository for teacher education is being developed under the Share.TEC Project (http://sharetec.it.fmi.uni-sofia.bg/). Share.TEC stands for "*Sharing Digital Resources in the Teaching Education Community*" (http://www.share-tec.eu/). It provides access to the partners' own content and to other teacher tducation repositories. Share.TEC is developing an online platform which will help practitioners across Europe search for, learn

about and exchange resources of various kinds, and will support the sharing of experience about the use of those resources. The system is primarily designed for teacher educators and for teachers engaged in pre-service education and continuous professional development. Share.TEC is devoted to fostering a stronger digital culture in the teacher education field and to supporting the development of a Europe-wide perspective among those working in and with the teacher education community. The intended users of the system will be teacher educators, teachers engaged in self-guided learning, and developers and publishers of digital resources. Share.TEC will be adaptive to the needs of the users and will take into account their professional profiles through an ontology-based approach designed to capture individual differences.

The TENCompetence project (http://www.tencompetence.org/) aims at supporting individuals, groups and organizations in Europe in lifelong competence development by establishing an appropriate technical and organizational infrastructure, using open source standards-based, sustainable and innovative technology. The freely available infrastructure will support the creation and management of networks of individuals, teams and organizations in Europe who are actively involved in the various occupations and domains of knowledge. These '*learning networks*' will support the lifelong competency development of the participants from the basic levels of proficiency up to the highest levels of excellence. The network consists of learners, educational institutes, libraries, publishers, domain specific vendors, employers, associations, and all others who deliver services or products in the specific field. A pilot experiment for lifelong competence development in ICT-enhanced (soft) skills based on the methodology derived in this project and the training strategy developed under under the project *Innovative Teacher - I*Teach* (http://i-teach.fmi.uni-sofia.bg/), has been carried out [15, 27]. A virtual community model for school teachers and experts was developed under the *I*Teach* project. The project aimed at providing a means to support teachers in their daily work and professional development in building new knowledge and skills and to motivate and help them to collaborate, share and reuse educational resources. The project supported creation of a virtual community of teachers and experts, development of a methodology handbook, creating digital repositories and establishment of **virtual training centers**. Such centers have been created in five countries, including in Bulgaria [20].

An example of applying some innovative instructional strategy in a web based learning environment created in the frames of the project WebLabs, is given in [22, 33]. The WebLabs provides an opportunity for *enhancing the scientist in the learner.* The students are involved in an international research project. They develop an understanding of mathematics as a science in which formulating hypotheses, carrying out experiments, solving open problems is its essence. The students are partners in a research process and can influence both the development of the computer environment and the design of the educational activities. They can communicate among themselves, with teachers and researchers both locally and globally. The teachers are seen as facilitators in a discovery process. They acquired specific social experience and were stimulated to build valuable personal skills such as: ability to generate and verbalize ideas; to present their results according to a concrete standard; to share their experience by means of electronic communication; to discuss their work and work in a team; to be (self) critical to the work published in the virtual environment. The existing e-infrastructure for e-science provides new opportunities for schools to get access to great number of virtual labs and **learn through interactive visualizations and simulations**.

The Sofia University internal project named *Elica* (http://www.elica.net/) has received a substantial international recognition among the mathematics educators. Some of the most important virtues of Elica are that an international virtual network of its users has been established [4]. Elica has been used for in-service teacher training for more than 6 years

now and a virtual community of teachers using Elica in their educational practice has been established. Being a general-purpose system, Elica can be used as a development platform for virtual worlds implemented through intuitive and interactive virtual reality. Several courses at Sofia University are based on Elica and they are for students which will become teachers in mathematics and computer science. Being in touch with the system that is used to implement a classroom software is an important factor, because several of the applications are already a part of the IT textbooks for 6th and 7th grades. Nowadays Elica is used in several national and international projects. Within the next year a dozen of new applications is supposed to appear. Additionally it will be possible to collect a more significant feedback from teachers and students.

Conclusions

The emergence of GCM universities and the Web 2.0 Schools is a world-wide phenomenon. The educators should work on a large scale of life-long learning activities for building new competency of teachers, students and all citizens of the information society. The technologies are ever changing and the new generations of Web are on the horizon – Web 3.0, Web 4.0, etc. They are related to increasing the intelligence of the Web. An emerging trend is the integration of the Web technologies with the global e-infrastructure in the academic world. Having in mind the trend of integration of all existing forms of education, we might expect the ultimate result might be that **the whole world would become a Global Campus** in the next few decades.

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