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Editorial

Dear authors, reviewers, and readers

It has been a month since I was given the privilege to serve as the Chief Editor of the International Journal for Innovation Education and Research (IJIER). It is a great pleasure for me to shoulder this duty and to welcome you to ***THE VOL-6, ISSUE-9 of IJIER*** which is scheduled to be published on **30th September 2018.**

International Journal for Innovation Education and Research (IJIER) is an open access, peer-reviewed and refereed multidisciplinary journal which is published by the International Educative Research Foundation and Publisher (IERFP). IJIER aims to promote academic interchange and attempts to sustain a closer cooperation among academics, researchers, policy makers and practitioners from a wide range of disciplines, which contribute to state of the art in science, education, and humanities. It provides a forum for the exchange of information in the fields mentioned above by welcoming original research papers, survey papers, and work-in-progress reports on promising developments, case studies, and best practice papers. The journal will continue to publish high-quality papers and will also ensure that the published papers achieve broad international credibility.

The Chief Editor, appointed by the Associate Editors and the Editorial Board, is in charge for every task for publication and other editorial issues related to the Journal. All submitted manuscripts are first screensed by the editorial board. Those papers judged by the editors to be of insufficient general interest or otherwise inappropriate are rejected promptly without external review. Those papers that seem most likely to meet our editorial criteria are sent to experts for formal review, typically to one reviewer, but sometimes more if special advice is needed. The chief editor and the editors then make a decision based on the reviewers' advice.

We wish to encourage more contributions from the scientific community to ensure a continued success of the journal. We also welcome comments and suggestions that could improve the quality of the journal.

I would like to express my gratitude to all members of the editorial board for their courageous attempt, to authors and readers who have supported the journal and to those who are going to be with us on our journey to the journal to the higher level.

Thanks,

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Would Criminal Sanctions for Patent Violations Encourage Violators to Respect Intellectual Property Rights?

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ABSTRACT

This paper analyzes the historical differences between copyrights and patents. Copyright law allows for criminal sanctions for violations. Patent law does not allow for criminal sanctions. The paper looks at this history and poses the question—Why the difference? The paper analyzes these differences and asserts that an imbalance exists between the two types of intellectual property that needs to be adjusted.

1.1 THE ORIGINS OF INTELLECTUAL PROPERTY LAW

This research traces the history of intellectual property law in the United States. It looks at differences that developed between patent and copyright law. The paper theorizes as to changes in patent law that could be made to buttress enforcement and reduce violations.

There are a number of theoretical articles about the origins of intellectual property law. One author discusses these origins as "Origin Myth" or "Origin Stories." (Silbey, 2008). The author discusses such myths as the creation myth and indicates that our notions of property rights in the Intellectual Property area are deeply rooted in those theories from childhood. Other scholars trace our patent system to the Statute of Monopolies passed in England in 1623. This statute codified what had been the practice for quite some time in England, namely the practice of granting to merchants what are called limited term monopoly rights for either new inventions or importers of new trade, (Walterscheid, 1997). Walterscheid indicates that the custom of granting limited term monopoly privileges actually dates back to the Italian City states of the fourteenth and fifteenth century.

A more recent and direct source of intellectual property rights would be the United States Constitution, article 1, section 8, which indicates that "the Congress shall have power to… Promote the progress of Science and useful Arts, by securing for limited times to Authors and Inventors the exclusive Right to their respective Writings and Discoveries." (U.S. Const. art. 1, § 8, cl. 6.) These 26 words constitute the entire constitutional foundation for American intellectual property Law. Our founding fathers clearly intended to protect intellectual property and to provide a mechanism for Congress to regulate in this area of law.

Congress wasted no time in passing legislation and the first Intellectual Property law was passed on May 31, 1790 (1790 Copyright Act). The act was a copyright act that dealt with "maps, charts, and books not exceeding one year." Some of the relevant portions of the May 1790 Act indicate:

> Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, that from and after the passing of this act, the author and authors of any map, chart, book or books already printed within these United States, being a citizen or citizens thereof, a resident within the same, his or their executors, administrators or assigns, who hath or have purchased were legally acquired the copyright of any such map, chart, book or books in order to print, reprinted, published work in the same, shall have the sole right and liberty of printing, reprinting, publishing and vending such map, chart, book or books, for the term of fourteen years from the recording entitled thereof in the clerk's office, as is herein after directed. (1790 Act.)

1.2 CRIMINAL PENALTIES ADDED TO COPYRIGHT LAW

At the time of the adoption of the constitution, and these early acts, all intellectual property rights and enforcement were civil matters. For the next 100 years, copyright enforcement was a civil matter. Not until Congress passed a new Copyright Act in 1897 did criminal penalties become a part of copyright law (1897 Copyright Act). That act stated that;

> "any person publicly performing or representing any dramatic or musical composition for which copyright has been obtained, without the consent of the proprietor said dramatic or musical composition, or his heirs or assigns, shall be liable for damages therefore, such damages in all cases to be assessed at such sum, not less than one hundred dollars for the first and fifty dollars for every subsequent performance, as to the court shall appear to be just. If the unlawful performance and representation be willful and for profit, such person or persons shall be guilty of a misdemeanor and upon conviction be imprisoned for a period not exceeding one year." (1897 Act)

It is quite interesting to note that the criminalization involved public performances of copyrighted works. It is also important to note that this law differentiates between "willful and for profit" conduct and other conduct presumably either not willful and/or not for a profit. (1897 Act) The point of who was covered by this first act that criminalized copyright violations is an important point. Performers were the primary target. Later on, in 1909 Congress amended the copyright act to include "aiding and abetting willful and for-profit infringement." (1909 Act.). Many scholars have suggested that the reason the act was expanded in 1909 was because the performers that were covered by the 1897 act, were primarily transient performers who move from town to town. It was next to impossible to sue them because to try to find their permanent home address was quite difficult. The 1909 act was passed to allow those who believed their copyrighted music and material was violated, could go after bar owners, theater managers, and others who were not quite as transient as the performers themselves (Copyright Act of 1909).

The 1909 Act was far more comprehensive than the 1897 act and included coverage for; author's writings, periodicals, newspapers, lectures, sermons, dramatic and musical compositions, maps, art, photographs and other categories. (1909 Act)

The 1909 Act provided that the above subsections were not intended to limit the applicability of copyright law only to categorize the areas. It extended coverage to foreigners that were domiciled in the United States at the time first publication of their work. That 1909 act spelled out copyright registration requirements, and generally provided for 28 years of protection for the copyrighted work, with the possibility of a 28 year

renewal. For purposes of this discussion, the most important provisions of the 1909 act included: Section 25 (e) which provided, in part that;

> Whenever the owner of a musical copyright has used or permitted the use of the copyrighted work upon the parts of musical instruments serving to reproduce mechanically the musical work, then in case of infringement of such copyright by the unauthorized manufacture…no criminal action shall be brought, but in a civil action an injunction may be granted upon such terms as the court may impose, and the plaintiff shall be entitled to recover in lieu of profits and damages a royalty as provided in section one subjection (e) of this act. (1909 Act)
>
> The 1909 act goes on to indicate in section 28, "That any person who willfully and for-profit shall infringe any copyright secured by this act, or who shall knowingly and willfully aid or abet such infringement, shall be deemed guilty of a misdemeanor, and upon conviction thereof shall be punished by imprisonment for not exceeding one year or by a fine of not less than one hundred dollars nor more than one thousand dollars, or both, in the discretion of the court" (1909 Copyright Act).

These provisions are quite important to review because the beginnings of a division in applicability of the act becomes apparent. Once again performers themselves are subject to criminal penalties. Others who willfully and knowingly aid or abet performers violating these provisions are also subject to criminal penalties. Excluded from criminal penalties are individuals who violate someone's copyright by mechanical method. This is an ironic distinction. In 1909 the cost of reproduction equipment was quite expensive.

Common ordinary performers and common ordinary citizens would not have access to reproduction equipment. The act essentially allows for violations of someone's copyright by mechanical means provided that royalties are paid as provided for in the act. The gist of this provision is to allow smalltime performers and artists to be charged criminally for violating the copyright act, but allowing large corporations, businesses and wealthy individuals that have mechanical recording devices to avoid criminal liability provided they pay royalties. It is important to note that even if the violation by mechanical means is willful and knowing, it is specifically precluded from criminal liability. Thus begins the very first clear demarcation between social economic classes in copyright law, and by extension intellectual property law. The same differentiation between social economic classes and how they're treated weaves its way throughout intellectual property law for the next three to four generations.

1.3 MODERN ERA CRIMINAL COPYRIGHT PENALTIES

Fast forward almost another 100 years to see other major changes affecting the criminal nature of copyright violations. Acts in 1971, 1974, and 1976 all expanded the criminal penalties for copyright violations (1909 Act). These acts continued to raise the penalties for copyright violations and the 1976 act finally included sound recordings, specifically. First offenses have penalties as much as $10,000 and second and repeat offenses have penalties as high as $25,000 (1971 Act).

The 1971 Act also recognized that willful infringement for-profit of mechanically reproduced recording parts should also be subject to criminal liability (1971 Act). The 1971 act provided a number of provisions including the requirement that copyrighted music and/or publications should indicate they are copyrighted

on the first page. The act further gives a better definition of what it means to be a sound recording (1971 Act). Nevertheless, sound recordings that are mechanically produced had not had full copyright protection. The 1971 Act spells out the purpose of the act to expand the protection afforded musical and print duplication to sound recordings. The act states that, "As a result, so-called 'record pirates' if they satisfy the claim of the owner of the musical copyright can and do engage in widespread unauthorized reproduction of phonograph records and tapes without violating federal copyright law… The purpose of section 646 as amended is twofold. First, section one of the bill creates a limited copyright in sound recordings, as such making unlawful the unauthorized reproduction and sell of copyrighted sound recordings (1971 Act). The 1971 Act states that "The attention of the Committee has been directed to the widespread unauthorized reproduction of phonograph records and tapes…The pirating of records and tapes is not only depriving legitimate manufacturers of substantial income, but of equal importance is denying performing artists and musicians of royalties and contributions to pension and welfare funds and Federal and State governments are losing tax revenues. If the unauthorized producers pay the statutory mechanical royalty required by the Copyright Act for the use of copyrighted music there is no Federal remedy currently available to combat the unauthorized reproduction of the recording…it is clear that the extension of copyright protection to sound recordings would resolve many of the problems which have arisen in connection with the efforts to combat piracy in State courts" (1971 Act).

It is quite clear from the passage above that Congress recognized a serious problem with the failure to protect sound recordings. The automatic royalty provisions of the 1909 act allowed unscrupulous businessmen to sell some recordings from musicians even though these musicians were not under contract to them for their particular recordings. The remedies of only being able to collect the actual royalty fees put the recording industry at a serious disadvantage. Congress saw this problem and corrected it. While this correction may have had a benefit to artists, it was primarily passed at the behest of recording studios. After signing artists and producing records they had no way to protect themselves from third-party manufacturers that reproduced the sound recordings paid the royalty fee, which allow them to sell these records to the public. Powerful recording industry tycoons and executives lobbied Congress for these changes.

Both the 1974 act and the 1976 act cleared up other issues and the 1976 act raised fines to $25, 000 for a first offense and up to $50, 000 for repeat offenders (1976 Act).

In 1982 Congress passed the Piracy and Counterfeiting Amendments act \of 1982. This act was intended to stem a growing amount of piracy for songs and software. This act called the "Piracy and Counterfeiting Amendments Act of 1982," indicates:

> "Section 2318. Trafficking in counterfeit labels for phonorecords, and copies of motion pictures or other audiovisual works;
>
> > "(a) Whoever, in any of the circumstances described in subsection (c) of this section, knowingly traffics in a counterfeit label affixed or designed to be affixed to a phonorecord, or a copy of a motion picture or other audiovisual work, shall be fined not more than $250,000 or imprisoned for not more than five years, or both."

This act once again raised the possible fines for violation to up to $ 250.000.00, and up to five years in prison for multiple violations. The 1982 Piracy and Counterfeiting Amendments act of 1982 was by far the

most aggressive and repressive copyright act passed by Congress. Amazingly, someone who was guilty of copying as few as seven videotapes could be fined as much as $25,000 and can spend up to one year in jail. This provision was enforced against a number of college students that simply copied movies for personal use. Clearly a violation of copyright law, but fines of $25,000? One year in jail? These penalties are an amazing degree of criminalization for relatively minor violations. In this instance, the 1982 act was passed at the behest of the recording industry in America. They were determined to protect their financial interests. Interestingly enough, the same recording industry in America battled and lost one of the major cases that would define the era. In the case of Sony Corporation of America versus Universal City Studios Incorporated, 464 US 417 (1984), Universal Studios attempted to force Sony to remove Betamax players from the market. Universal City Studios along with other recording industry executives and companies claimed that Sony's Betamax recorder was designed specifically to violate their copyrights and copyright protected music and videos. Sony countered that the Betamax player had other non-infringing uses and that simply because it had the capacity to copy videos did not make it illegal. In a landmark ruling in 1984 the United States Supreme Court agreed with Sony. They reversed the Court of Appeals that had held that Sony was liable for contributory infringement of copyrights. The court indicated that there was a significant likelihood that free television programs and other recordable events could be recorded that would allow consumers to time shift their watching habits and that this was not a violation of copyright law. New acts in 1992 and 1997 addressed the problem related to the new digital environment. The 1997 act became known as the NET act, and increased potential fines to as much as $100,000 with penalties as much as one year in prison.

1.4 COMPUTERS ADDED TO COPYRIGHT LAWS

The last act passed by Congress is known as the Digital Millennium Copyright Act (DMCA). This 1998 act raises the stakes significantly. First-time offenders can be fined as much as $500,000 and imprisoned for five years or both. For repeat offenders the maximum penalty is $1 million and maximum time in prison up to 10 years, or both (DMCA)..The Digital Millennium Copyright Act was Congress' attempt to catch up with the new digital environment. The act also incorporates and implements the World Intellectual Property Organization (WIPO) Copyright Treaty and Performances and Phonograms Treaty. This all pervasive act, dealt with not only recording industry concerns, but also the burgeoning computer industry. By the passage of this act, many were aware that we were living in an entirely new age of computers and computer technology. Notwithstanding this awareness, Congress never did fully grasp, as probably most people did not, how ubiquitous computer technology would become in our everyday lives. The Digital Millennium Copyright Act (DMCA) was quite broad at the time of its passage. It did not take long for the problems associated with digital media, and the brave new digital world to outpace the confines of the act. Notwithstanding the warp speed that new inventions were permeating society, The DMCA did accomplish some noteworthy goals. One of the most important provisions of the DMCA are the safe harbor provisions for online service providers. The safe harbor provisions allow online service providers to not be held liable for allegedly infringing material provided that they follow certain guidelines. If they operate within these guidelines, and either promptly remove or block access to allegedly infringing material in a timely fashion

when they've received notification of infringement claim from a copyright holder, they will avoid liability as a company (DMCA). Ironically, this provision of the DMCA codifies what ultimately case law started to conclude. The Internet turned copyright law on its head. Prior to Internet law, copyright law places the onus of compliance with copyright provisions on the infringer. The law had positive proscriptions indicating that certain behavior was illegal or improper under copyright law. It was left up to the potential infringer to avoid such conduct. A number of cases, primarily led by Google, Incorporated led the fight to allow Internet service providers to provide Internet content irrespective of potential copyright violations. The notion that someone holding a copyright or their agent has the responsibility to notify ISPs of infringing conduct is a new development in copyright law. The DMCA sets the new paradigm into statutory law. We now have to compare how copyright law evolved with the much briefer history of how patent law evolved.

2.1 PATENT LAW HISTORY

The first patent act was passed in 1790. This act allowed patents for "any art, manufacture, engine, machine or device," (1790 Patent Act). According to one scholar, the American Patent Act of 1790 was "the first statutory enactment by any country obligating any form of examination to determine whether a patent should be granted," (Walterscheld, American Patent Law and Admin., 1997). Walterscheld goes on to indicate that the idea of absolute novelty was a uniquely American idea. England as well as the Italian City States did not insist on absolute novelty, only newness to the particular area where the practice was being introduced. The 1790 act required actual novelty, (Walterscheld, American Patent Law and Admin., 1997) Just a few years later in 1793 the act was amended to include "composition of matter, " as well as to impose a registration system akin to the British system in lieu of examination, (Walterscheld, and 1793 Act). Patent law statutory history is quite short as compared to copyright law statutory history. The 1952 statute amended the 1793 act and laid out what would become the scheme for patent protection since that time. Under the 1952 act, eligibility for a patent requires four things. Utility, novelty, non-obviousness, and sufficiency of disclosure (1952 Act). The vast majority of activity regarding patent law has been within the court system. One of the major topics of historical disagreement has been what has been called "the Jeffersonian story of patent law." According to advocates of this school of thought, patent law grants a special monopoly privilege to a few not justifiable under concepts of natural philosophy. The idea behind this notion is that Congress passed the Sherman act making monopolies illegal, yet somehow or another people with a patent are able to have a monopoly. This concept had been buttressed by statements from Supreme Court justices in their opinions which seemed to support this notion. Other scholars tend to disagree with the theoretical paradigm and postulate that patents are nothing more than property rights, (Mossoff, 2007)

2.2 THE AMERICA INVENTS ACT

The America Invents Act presented wholesale changes to the US Patent system by changing from a first to invent to a first to file system in harmony with the rest of the world, (Leahy-Smith Act, 2011). This major change to the patent system was the most extensive change in over 100 years. By changing to a "first to

file" system, the act places the responsibility of protecting patent rights squarely within the inventor's control.

3.1 CRIMINAL COPYRIGHT AND PATENT LAW DIVERGENCE

Of importance to this discussion is how patent law and copyright law diverged into two completely separate paths. This is quite interesting considering their common origins in the constitution. It is amazing that this area has not been fully developed. There are very few theories in the body of research that attempts to explain why the major differences between copyright law and Patent law evolved. What can fully explain the different treatment between the two intellectual property areas? While the history of criminal sanctions can be traced from its misdemeanor origins for copyright law to ever increasing fines and longer sentences for copyright violators, the absence of any corresponding criminal penalty or sanction for patent law violations is stark. When we consider the fact that the first misdemeanor criminal sanction for copyright violations was passed in 1897. Why is it that well over 100 years later, no criminal sanctions have been passed regarding patent violations? Ideas of criminal sanctions for patent violations are not completely novel. The European Union considered such sanctions when they recently updated their intellectual property laws. Ultimately, they decided not to impose criminal sanctions for patent violations. When looking at the impact to society for patent violations versus copyright violations, many argue that patent violations have a larger impact. It may be true that more people are involved in copyright violations. That is not the same as saying that the impact is larger for copyright violations. Most recently in the news, most people should be aware of what have been termed as the "smart phone patent wars." The major lawsuits in these wars have been between Apple Computer Incorporated and Samsung Electronics Company, Limited. These multimillion dollar battles involve billions of dollars in profits. Apple has claimed that Samsung has violated their patents that make their smart phones unique. On the other hand Samsung has made the same claim. Recently, in May 2018, Samsung was ordered to pay Apple 539 million dollars in damages (Bloomberg News). One thing is certain; there are billions of dollars at stake in a lot of patent litigation. It seems obvious on its face that someone or some individuals at one or both of these companies must assume some responsibility for the intentional violation of patent protections. It is inconceivable that corporate executives at Apple or corporate executives at Samsung are totally unaware of any infringing activities by their companies. After the millions of dollars spent in litigation, numerous depositions, interrogatories and discovery requests, we can presume that everyone at either or both companies innocently and unknowingly infringed on the others' patent rights? This is next to impossible to fathom. Engineers, technologists, and other employees have to have some awareness where they got the ideas or technology that forms the basis for these lawsuits. With this much evidence in existence, how hard would it be to mount some sort of criminal investigation that held some of the parties liable for their behavior? Theories that purport to write off the possibility of patent criminal liability based on the difficulty of prosecution are misguided. If given the statutory authority to proceed with criminal prosecutions, there are some industrious prosecutors that would quickly build solid criminal cases going after some of the worst and most flagrant offenders.

3.2 CORPORATIONS TREATED AS PERSONS

In the last 10 years or so the United States has embarked upon a relative paradigm shift in how corporations are treated. The Supreme Court has on a number of occasions indicated that corporations are in fact people. They've indicated that corporations have rights, duties and obligations stemming from their citizenship as people. In one such case Citizens United v. Federal Election Commission, 558 US 310 (2010), the Supreme Court held that companies and unions could spend as much as they like to defeat political candidates. The decision essentially recognized First Amendment free speech rights for corporations. The Supreme Court as well as lower courts have begun to impose corporate criminal liability on not only corporations but also individually on corporate officers. This new theoretical paradigm posits that those who run corporations must personally be liable for the behavior of those corporations to assure that these businesses fulfill all of its obligations to the society. Although the idea of corporate criminal liability is not entirely new, its imposition to officers and directors has evolved in recent times, (see for example, Dodd-Frank). After a number of corporate scandals, as well as corporate failures, the United States passed what became known as the Dodd-Frank act. This act specifically provides that officers and directors of a corporation are charged with the responsibility of knowing what is happening in those businesses. Failure to understand what's going on, when you are in a position of leadership, is not an excuse for avoiding criminal liability. The Dodd-Frank act specifically imposes liability on these officers and directors who are in a position to know what the business is doing, (Dubber, 2013)

3.3 EXPLORING THE DIFFERENCES IN CRIMINAL LIABILITY

Why is their duplicity in liability for corporate officers and directors when it comes to patent infringement but clear liability when it comes to other kinds of corporate misconduct? On the one hand, Dodd-Frank imposes civil and criminal liability to these officers and directors that violate financial, disclosure, and/or ethical rules and regulations. Patent infringement is like the 800 pound gorilla in the room. The fact that Apple and Samsung are involved in over 50 lawsuits with each other regarding patent infringement gives us some sense as to how important these issues are and the real scope of potential violations (CNET, 2012). Most analysts would indicate that the potential loss to business for patent infringement approaches billions of dollars. Although the estimates are all over the board, they are all in the billions.

That being said, it is difficult to justify why a college student that downloads ten songs without permission is subject to criminal prosecution, but an executive of a major corporation can supervise the theft of billions of dollars in protected patent property, and face no criminal sanctions whatsoever. How could this possibly be fair? Many have tried to argue that the reason why there are no criminal sanctions in patent law is because it will be difficult to prove criminal liability. There certainly may be some truth as to the complexity of patent law, but as demonstrated earlier, that is not an excuse for not having protections and sanctions in place for obvious violators.

Let's take a look at the patent process to make some reasoned judgments as to whether or not criminal liability can be imposed for infringers. In a successful patent prosecution (the term prosecution is used to refer to obtaining a patent) certain things must occur. First, the inventor must describe the invention in writing. Second, the application must "enable any person skilled in the art to which it pertains… To make

and use" an invention. Third, a claim has to be clear and concise. Fourth, the inventor must "set forth the best mode contemplated by the inventor of carrying out his invention." (Mendez, 2008).If the Patent Office can engage in this deep level of analysis, and patent litigators engage in this deep level of analysis when prosecuting and defending their patent infringement cases, why should we be concerned that other specially trained lawyers and paralegals cannot navigate successfully any potential pitfalls with successful criminal prosecution?

The United States patent act as currently configured prohibits "whoever without authority makes, uses, offers to sell, or sells any patented invention, within the United States or imports into the United States any patented invention during the term of the patent therefore, infringes the patent" (35 USC). Some argue that prosecuting patent infringers would be too difficult. The reasons given are that the criminal courts are not qualified to deal with these patent issues. This argument suggests that patent issues are so complex that judges would not be able to understand what's going on. If that is true then there should not be any civil violations for patent infringement. Just like civil judges have to learn the particulars of patent law, so criminal law judges and prosecutors would have to learn about patent law. It is also quite clear that prosecutors would have to use reasonable judgment in which patent infringers they go after. This level of discretion is not new to prosecutors. Exercising discretion as to whom they should prosecute is part and parcel of what prosecutors do every day. Why would making that assessment in a patent case be any different than the assessment that prosecutors make in any case? In a case that is a close call, prosecutors would certainly have the discretion not to bring criminal charges. In other scenarios, criminal Sanctions may be imposed if a foreign nation is involved in stealing official American secrets (Economic Espionage Act, 1996)

3.4 WHITE COLLAR CRIMES TREATED DIFFERENTLY

Edward Sutherland postulated way back in the 1960s a new concept of criminal liability. He coined the term “white-collar crime". Edward Sutherland used this phrase to refer to criminals that may be educated, and are almost always financially well-off, and can wreck-havoc in society by stealing from and misusing corporate assets with impunity, (Friedrichs, 2004). It is still a common occurrence in the United States for someone that might be guilty of stealing a few hundred dollars’ worth of goods from the local grocery store to be sentenced to more time in prison then a corporate executive that may have stolen millions of dollars including retirees’ life savings. There is no question that this imbalance has improved over the last twenty years. Notwithstanding the improvement, it is still common that white-collar criminals are treated with kid gloves as compared to the street criminal that may have likewise did no physical harm to the victim. Once again, we go to the analogy of a college student that downloads ten copies of protected music illegally. The student is prosecuted for and convicted of criminal copyright infringement. Hypothetically, on the same campus a professor intentionally steals protected patented information and ideas from another company. The professor understands fully that these inventions are patented. With full intention of wrongdoing the professor infringes on the patent and improperly incorporates the patented invention into a product for his own startup company. The way the law stands right now, the student goes to prison, while the professor goes home to dinner. How could that possibly be fair? The idea that Patent Violations are immune from

criminal prosecution is inconsistent with the entire notion of protection of individual and corporate privacy, property and intellectual property rights. The distinction that exists today, that allows a college student to go to jail for downloading a few songs illegally, but allows executives of major companies to escape any criminal liability whatsoever for multi-million dollar theft of patented inventions flies in the face of fairness. The scales of justice need to be balanced.

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X-ray Investigation of Microstructure and Properties Evolution on Superalloy Inconel-718 derivative during Rapid Joule Heating and Severe Plastic Deformation In-situ

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ABSTRACT

The purpose of this study is to X-ray line-profile analysis of the effect of rapid Joule heating and severe plastic deformation in-situ on microstructure and properties evolution in polycrystalline austenitic Fe-balanced superalloy EP718E, which is Inconel 718 derivative. The microstructure of superalloy at different stages of processing was examined by X-ray diffraction, by scanning electron microscopy, and by energy dispersive spectrometry techniques. The mechanical properties evolution was studied by means of tension and high cycle fatigue testing's. The results of X-ray study show that the intensity, raw areas and net areas were step–by–step changed according to processing routines. Is shown that under shear stress the fcc-crystallites were deformed and the peaks parameters by 2-Theta scale changed partly.

Keywords: X-ray line-profile analysis, Inconel-718 derivative, electric upset forging, crystallites deformation, high cycle fatigue.

1. Introduction

In modern aircraft bypass turbofan engines [1] the most stressed parts, which define engine resource and lifetime extension, are the high pressure compressor (HPC) rotor blades. The rotor blades of HPC experience tension stress during rotor rotation at centrifugal forces, and torsion bending at the air flow. The blades are stressed by tensile-compression loads at vibration with different voltage levels. The amplitude and frequency of stresses varies in a wide range of voltages depending on the number of blades on the rotor stage and the number of blades on the stator stage as well as the rotor rotation frequency of turbojet engine [2, 3]. Uneven heating leads to cracks due to thermal stresses, which can develop into fatigue cracks [4]. In addition to the mechanical loading, the HPC blades operate in a corrosive air environment during long-time exposure at high temperatures [5, 6]. The temperature increases take place during supersonic flight as result of air braking and air compression in the compressor. The temperature on the last stages of the HPC blades increased up to 600-700 ºC. This necessitates the manufacture of the HPC

blades from polycrystalline NiFeCr-based superalloy Inconel 718 (IN718) [7] or its derivatives like EP718E [8]. These superalloys have small differences on chemical compositions and microstructure (see Tab. 1). IN718 is an age-hardenable austenitic Fe-balanced superalloy [9]. The mechanical strength of this material is largely dependent on the precipitation of a γ'-phase forming during thermomechanical treatment for producing optimum properties [10]. The microstructure of IN718, especially with regard to the effects of heat treatment, has been extensively studied and reported in [11]. The minor phase's evolution of IN718 takes place during long-time exposure at high temperatures and the principal phases γ', γ" and δ were coarsened. The literature has to be consulted for detailed discussions on the various phases developed by various heat treatments and other investigations of metallurgical processes [12-14]. An additional problem is associated with naval aviation. On aircraft carriers and on helicopter carriers, the turbo jet engines of the fighters and of the helicopters ingest salt from seawater. Salt leads to the destruction of superalloys by grain boundaries at intercrystallite erosion. By this the hydrogenated IN718 show ductility decreases (at tension) as well hydrogen embrittlement sensitivity of this alloy [15-16]. Thus, prolonged work in these conditions needs materials with specifically improved properties. Unfortunately, the influence of the rapid Joule heating by electric current with high density and severe plastic deformation (SPD) concurrently at different levels of heating rate and deformation degree have been studied in our own previous works [3, 17, 18] only. This technique for exploitation properties of superalloy IN718 and EP718E improve called as electric upset forging (EUF) process. For the deep study of these changes in material during thermo-mechanical processing and exploitation the powerful X-ray test technique [19-21] can be used. It is common knowledge that the peaks of X-ray intensities depend on material thickness, grain sizes, dislocation densities as well as porosity, both of which determine how X-rays penetrate, dissipate, absorb, and deflect. The anisotropic deformation during the EUF process can lead to the formation of anisotropic crystallites and consequently anisotropic X-ray peak broadening. The objective of the current study is to review by X-ray line-profile analysis at different stages of samples processing the effects of the rapid Joule heating and severe plastic deformation (SPD) concurrently (at different levels EUF processing and at followed die forging) on microstructure evolution and properties improve of material.

2. Experimental

Chemical composition of polycrystalline superalloy IN718 [7] and EP718E [8] (derivative of IN718, used in experiments), is presented in Table 1. As shown, the chemical content of superalloys has very small differences on Ni and Fe contents. The light elements (C, Si, Mn and B) are not presented in Table 1 for superalloy EP718E. The EP718E is an experimental alloy and its chemical composition is measured in four samples by (HR SEM - Gemini, LEO, Supra 35) SEM-EDS testing. The X-ray investigations were made by X-ray diffractometer D5005 Bruker AXS according to Database: ICDD PDF-4+2014 in middle part of cross-sections of EUF processed sample (Fig. 1, a, b). The X-ray patterns are presented without K-alpha2 lines and smoothed with Fourier filter. The peaks parameters are calculated after debugging. It has to be noted that before X-ray testing the cross-sections of samples were cut to identical measures. The microstructure evolution and precipitations content changes were studied across four stages of processing: I – initial condition of heat rolled rods, II – heat treated up to deformation starting temperature, III –

deformed up to 5-10% of strain, and IV – deformed up to 80 % of strain. Two zones of severe plastic deformation (SPD-I and SPD-II) by white dot lines are shown in Fig. 1, b. We propose to compare the two different technologies for HPC blades preforms manufacturing: by conventional technology and proposed technology that employ an electric upset forging (EUF) technique. This process, characterized by a rapid Joule heating and severe plastic deformation, is concurrently the workpiece part under upsetting that is heated up to a temperature at which deformation starts under corresponding axial compression stress. Preforms profiling was conducted on the EUF machine tool "Hasenclever-125/560". The initial samples have diameters of 12 mm and lengths of 85 mm. We propose for rods profiling a continuously consistent way [17] of EUF without admission on non-deformable length of the rod under fine die forging of the HPC blades (Fig. 1, a). For processing the radial electrodes (Fig. 1, a, 5 and 7, respectively) their length was increased to two length of rod workpiece before processing and the punch has a lower diameter then the workpiece. The EUF parameters were the following: effective deformation load F_d = 62 kN, electric current I = 4300 A, current density i = 38 A/mm^2, heating rate Δt = 130 ºC·s^{-1}, heating time up to deformation starting τ = 7 s, deformation starting temperature t_1 = 910±5 ºC, maximal temperature inside of the sample deformed part was increased to t_2 = 1020±5 ºC. During EUF the diameter of samples was increased from 12 mm to ~30 mm (Fig. 1, b) and at follows the EUF processed preforms were die forged on press without (or with) additional furnace heating. The macrostructure of EUF processed preform under die forging of HPC blade in longitudinal section is shown in Fig. 1, b. This technique also includes high accuracy die forging under isothermal conditions on a hydraulic press immediately after profiling the round sample and stamping with high accuracy on an electric stator press followed trimming of flash in trimmer die by the crank press. At follows the 6 forgings and for comparison 6 forgings produced by conventional technology were heat treated at 1000 ºC for 2 h and cooled in oil. Then the 1-st aging was made at a temperature of 780 ºC for 5 h with air cooling; 2-nd aging was made at 650 ºC for 16 h followed air cooling. According to these techniques, after mechanical cutting of the dovetail root-blade, the HPC blades were cold rolled to measures and the surface of each blade was polished to finish.

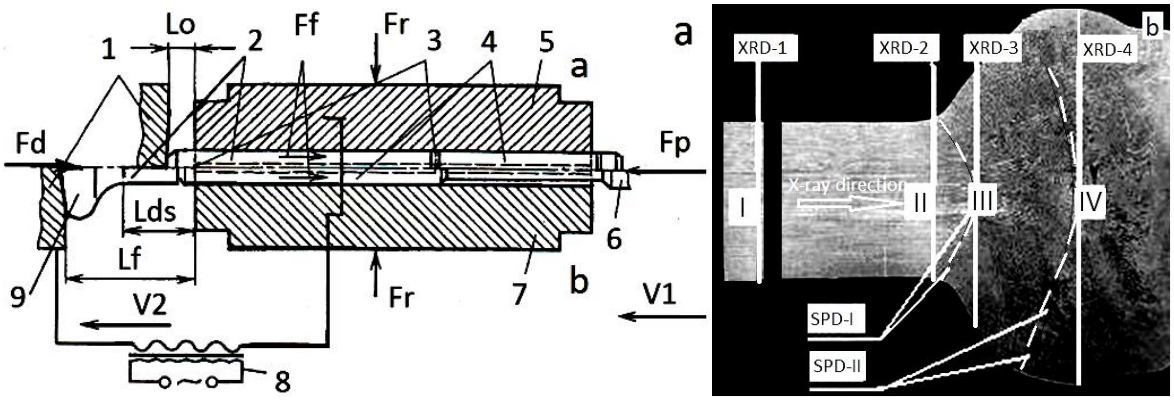

Fig. 1. Scheme of a continuously consistent method [17, 18] for HPC blades preform manufacturing according to proposed EUF process. Designations (in Fig. 1, a): a - initial stage (hight) of EUF process; b-end stage (lower) of EUF process; (c) L_o – initial distance between electrodes, L_{ds} – distance of deformation starting at heating, L_f – final distance between electrodes; (d) F_f – friction force, F_r – radial loding force for pressure of radial electrodes to sample, F_p – pressure load, F_d – deformation load; (e) V_1 – punch rate of

the sample moving, V_2 - removal rate of the end electrode; 1- end electrode, 2- samples, 3 – conical end part of sample, 4 – cilindrical rods at starting measures, 5 – upper radial electrode, 6 – punch, 7 – lower radial electrode, 8 – electrical transformer, 9 – upsetted preform under HPC blade die forging. The XRD testing zones in cross-section of preform as well as X-ray direction and SPD-I and SPD-II regions, and microstructure investigation zones (I-IV) in longitudinal section of preform are indicated in Fig. 1, b.

Table 1. Chemical compositions of superalloys IN718 [7] and EP718E (SEM-EDS).

Material	Ni	Fe	Al	Ti	Cr	Mo	W	Nb	Si	C	B	Mn	%
IN718	53.38	17.01	0.6	1.08	18.9	3.15	0.1	5.48	0.04	0.04	0.01	0.04	99.83
EP718E	42.84	27.66	0.8	2.42	14.84	4.72	5.14	0.96	-	-	-	-	99.4

Material tension strength was investigated by examining mini samples (at least 3-4 samples for one test region) which were cut off from initial material and all three stages of EUF processing as well as from HPC blade dovetail root-blade. The mini samples for tension testing have dimensions of 0.5x2x5 mm on test part. The HCF tests of finished blades of 6 pieces for two manufacture technologies were performed on an electrodynamics shaker at ambient temperature with frequency rate of $F_{1,0}$ = 1110 - 1180 Hz. The high cycle fatigue (HCF) was studied on four test intervals at loads with corresponding stresses of 260-360 MPa, 360-440 MPa, and 360-440 MPa (for blades produced by conventional technologies, for comparison) and 440-600 MPa (for HPC blades produced by proposed technology), respectively. During the HCF test the level of stress was set with the step-by-step load increase and the endurance data for EP-718E was received. The tests were carried out for different values of δ_{-1}, which are altered in stages. If any voltage value had achieved N = $2x10^7$ cycles without failure, the δ_{-1} was increased to 40 MPa and the test was repeated with the new voltage up to N = 2 $x10^7$ cycles. If failure occurred, then the load was reduced by δ_{-1} = 40 MPa for other HPC blades. The HCF tests was limited by the maximum stress level of δ_{-1} = 600 MPa.

Results and Discussion

3.1. X-ray investigation

The X-ray investigation of line-profile analysis of the 5 peaks (Fig. 2, a) in interval from 40º to 100º of 2-Theta were investigated. The parameters calculated and results are presented in Fig. 3 diagrams. Dependence on processing stages the X-ray intensity was increased mainly at all steps of processing (Fig. 2, b-f and Fig. 3). The intensity was decreased during Joule heating as the grain boundaries (GB) structure was changed. The parameters of peaks like width (or half-width) and the shape of the geometry of the surface were calculated (Fig. 3, b). They depend on the first try - it is a plane, or a convex, or concave, or smooth. The material grain size and the crystalline degree has influenced on the X-ray intensity also. For example, from the large single crystal the thinnest peak can be formed, increasingly finer crystal diffraction broader peak until the transition to the amorphous state. The peak is going to a very wide back-cloths, recovery of material density how deep X-ray beam in the material penetrates, peak geometry again depends on effect of the processing modes and parameters. The intrinsic tension in the deformed material is

available. Part of the crystal planes either compressed or stretched out - their levels by diffraction radiation intensity maximum shifts the 2-Theta scale slightly and gives results in wider alliances of peak.

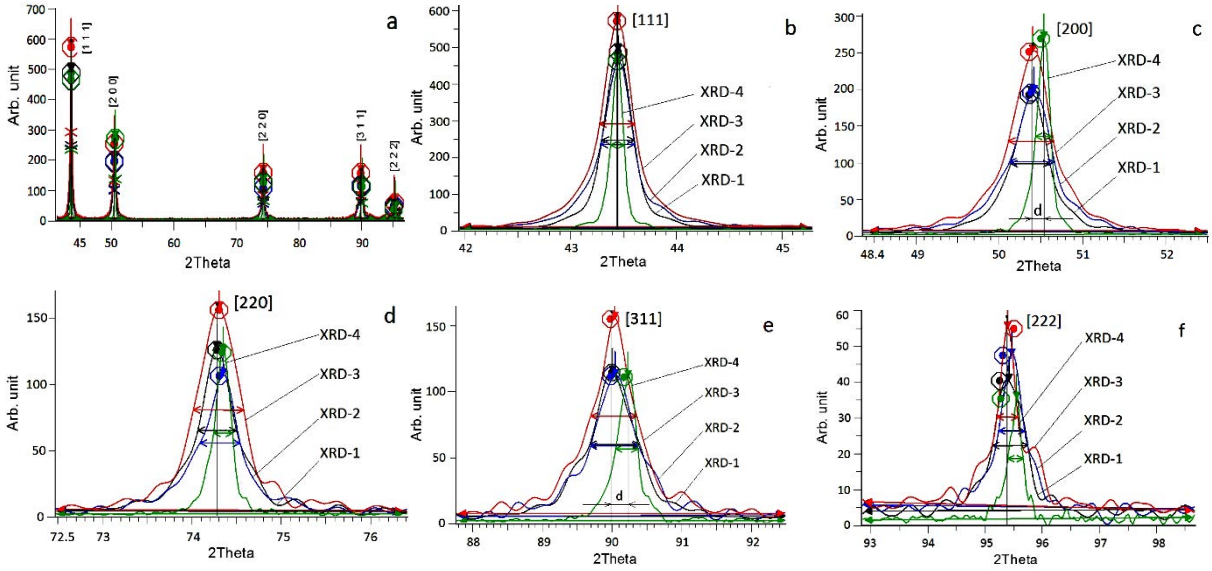

Fig. 2. The measured X-ray diffractogram (a) and fife peaks (b-f) for [111], [200], [220], [311] difractograms of initial (XRD-1), Joule heated (XRD-2), Joule heated and deformed about 5% of strain (XRD-3), and Joule heated and deformed about 80% (XRD-4), respectively.

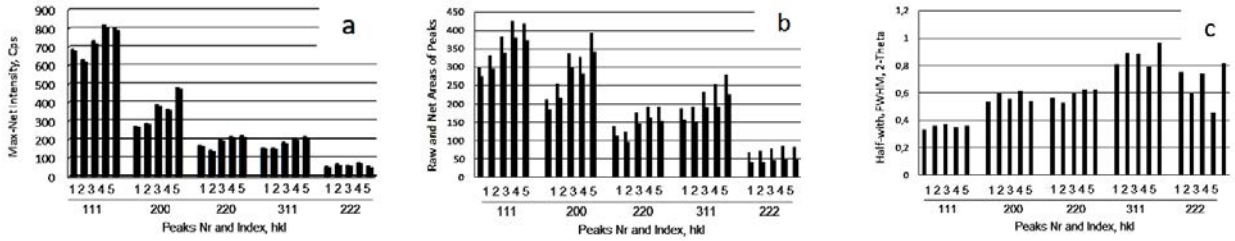

Fig. 3. X-ray peaks calculated parametes: a - Maximal and Net intensity of peaks, b - Raw and Net areas of peaks, c - Half-width, FWHM, of 2 - Theta.

The distances (d) on planes [200] and [311] were changed (Fig. 2, c and e) as the crystallites were deformed under shear stress. To protect from the continuous oxidation of the grain boundaries is necessary to eliminate the defects of the microstructure, which limits the diffusion of oxygen into the material.The microstructural analyzes show that the microstructure heterogeneity of superalloy is due to differences in the deformation. In doing so, the material heats up at different rates, and the heating rate depends mainly on current density. As a result, the metal in deformed part of sample has different temperatures at the end of EUF process. At such heterogeneity of temperatures and intrinsic stresses, compression stress in central part and tension stresses on surface, leads to forming different microstructures and mechanical properties.

3.2. Microstructural investigations

The hot rolled rods' initial microstructure (Fig. 4, a) before EUF processing shows many small bores on boundaries confluences of three grains as metallurgical defects. The maximal sizes of bores was about 200-300 nm (Fig. 4, b). The eliminating of microstructure defects like ultrafine size bores at the confluence of GB and GB improve is the main requirement for proposed technology. These defects cause the metal

intergranular erosion by hydrogen of HPC blades mainly in the naval aviation [15, 16]. At follows we show also by high cycle fatigue (HCF) testing, that during EUF processing the elimination of nanoporous increases the life extension of HPC blades. During Joule heating concurrently with small (to ~5%) degree of deformation the grain size was increased from ~10 μm to ~20 μm or about two times (Fig. 5, b) on second stage of processing. Such evolution of microstructure during processing is shown in Fig. 5. The figure shows grain size increasing during rapid heating with very small deformation as evident in Fig. 5, b. At increased degree of von Mises strain during severe plastic deformation (see Fig. 1, SPD-II) the grain size was significantly decreased to some micrometers in size (Fig. 5, c) at strain of 80 %. The slip bands were formed inside of grains and the dislocation density increased, respectively. The changes in the chemical state of phases in initial and three sections after the high-speed electric-heating and severe plastic deformation of workpiece were investigated by electron diffraction technique (Fig.6). In our study, we consider the billet of superalloy as a closed system wherein the amount of chemical elements in material was constant during processing (see Tab.1. EP718E). The results achieved by SEM-EDS investigation are presented in SEM scans in Fig. 6 and in Table. 2, respectively. The microstructure also contains Cr-Mo-W-rich compound, and Ti-Nb-C and T-C carbides. The results of SEM-EDS investigation show that precipitation phases' content is about 1.9 wt.% in alloy. The changes in chemical composition of GB was tested by leaching in HCl acid. The comparison of GB leaching of initial (is presented in Fig. 4, c, d) and by EUF processed material (is presented in Fig. 4, e, f), respectively. It can be seen that the material GB after proposed EUF process with 80 % of deformation, is stable to chemical leaching as well as to sea water influence on GB erozion during exploitation in naval aviation.

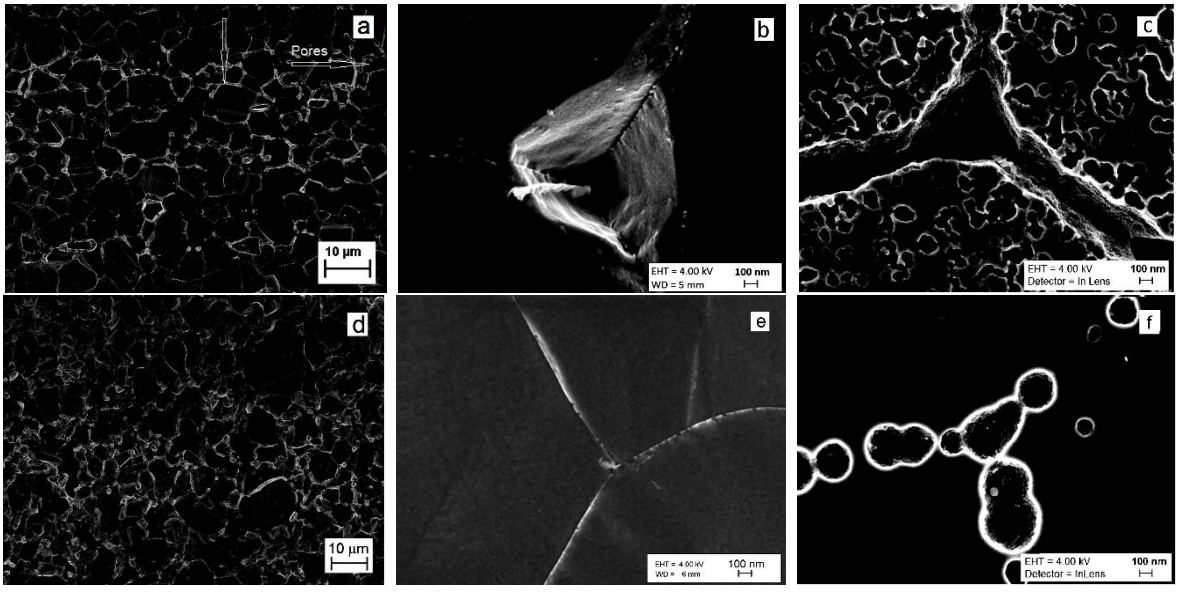

Fig. 4. The SEM scans of the initial EP718E sample (a), the metallurgical defects, pores at the confluence of three grains (b), triple GB erosion after chemical etching (c) and after EUF processing (d, e) and followed chemical etching with HCl (f).

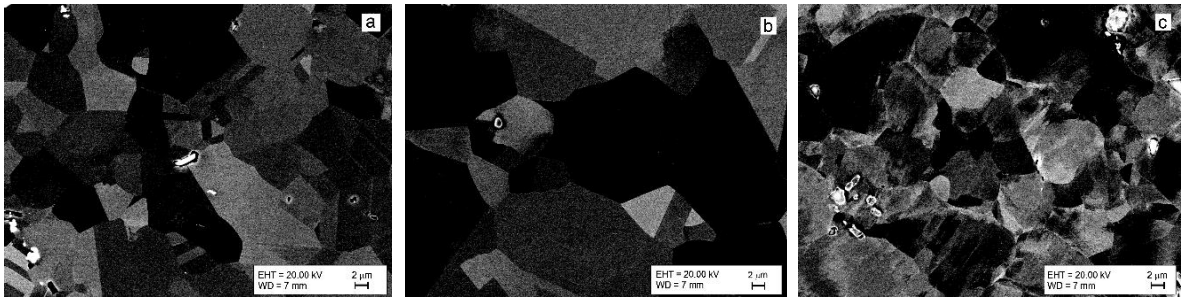

Fig. 5. The SEM scans of the sample after rapid Joule heating (a), deformation to 5% (b) and deformation up to 80%, respectively.

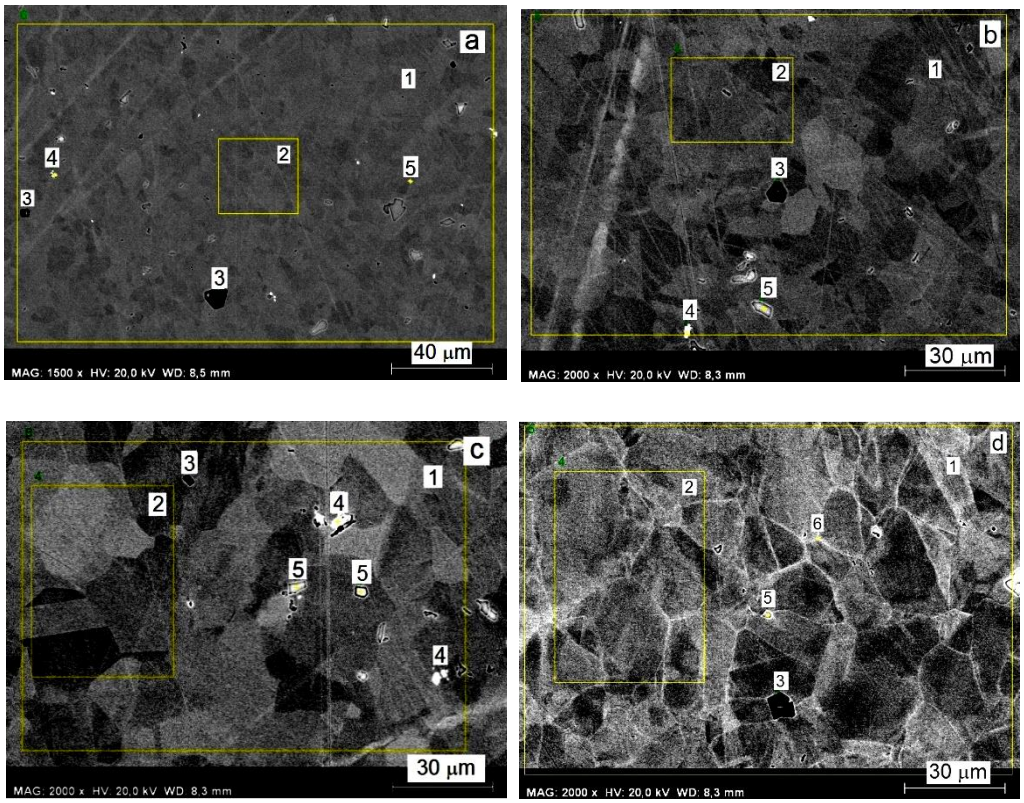

Fig. 6. EDS-SEM investigation of chemical compositions in samples: a – initial, b – rapidly Joule heated, c – heated and deformed to ~5% of strain and d – heated and deformed to 80% of strain. Definitions (in Tab 2): 1 – all surface include phases, 2 – surface with no inclusions, 3 –Ti-rich areas (black), 4 –Ti-Nb rich area (light-gray), 5 –Mo-Nb-W rich area (white), and 6 – newly formed GB area with Ni-rich chemical composition (in Fig. 6, d).

Table 2. Mean chemical composition of the alloy IN718 derivative and its phases.

Phases Nr in Fig. 6.	Ni	Fe	Cr	W	Mo	Ti	Nb	Al	Wt. %
1. EP718E	42.84	27.66	14.84	5.14	4.72	2.42	0.96	0.81	99.4
2. No precipitations	42.79	27.22	14.36	5.07	4.52	1.96	0.78	0.8	97.5
3. Ti-rich	1.57	1.17	0.89	-	-	88.78	3.14	-	95.6
4. Ti-Nb-rich	1.55	1.15	0.98	6.93	-	35.98	50.6	-	97.2
5. W-Mo-rich	16.01	14.5	12.4	13.3	28.1	2.67	7.15	-	-
6. GB	45.32	26.63	14.99	5.42	4.94	2.83	0.78	0.88	101.78

3.3. Tension and HCF testing's

Results show that the initial material (Sample N1, Conventional) shows highest value at tension revealed to 1266 MPa but the minimal elongation of 22 % to failure (Fig. 7, a). During rapid Joule heating (Sample N2) with heating rate of 110 °C/s the tensile stress was decreased to 1015 MPa and elongation increased to 55 %. During SPD starting at 5 % (Sample N3) the heated material tensile stress increased to 1064 MPa but elongation decreased to 48 %. By increasing SPD to ~80 % (Sample N4) the elongation was increased to 56 %. Compared to initial material the Young modulus was lowered during rapid heating (see initial loops of curves N2, N3 and N4). During furnace heating and die forging decreases the tensile stress to 957 MPa, but the Young modulus (see Fig. 7, curves N5 and N6) increased significantly. Results shows that Young modulus of materials was lowered during EUF, suggesting that during rapid heating decreases the interatomic forces. The Young modulus increased at followed die forging of preforms. High cycle fatigue (HCF) and high-frequency strength (HFS) are important quality properties of HPC blade material as they determines the resource of the turbo-jet engine.

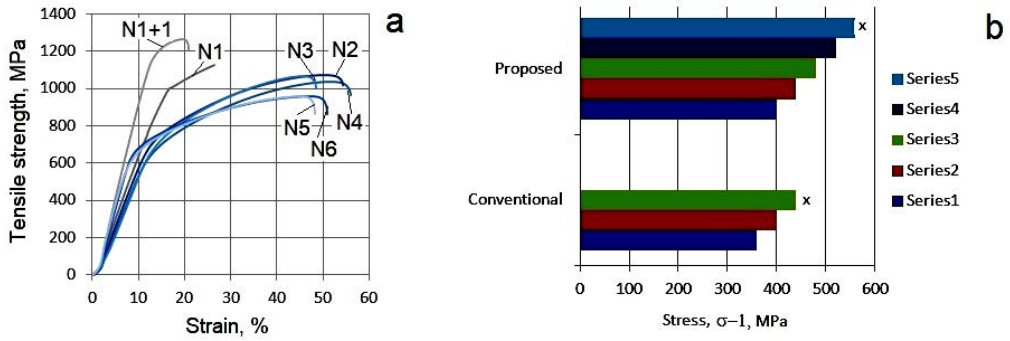

Fig. 7. Tension stress (MPa) at corresponding strain (%) curves (a) and endurance data at HCF cyclic tension-compression stress (δ_{-1}) values (b) dependence on processing technologies (Conventional - Proposed) at corresponding test series of EP718E superalloy. By asterisks (in b) is shown fracture at corresponding stress (δ_{-1}) values and at cycle's number lower then $2x10^7$.

Results of HCF testing of blades produced by conventional technology show that the maximal fatigue strength δ_{-1} = 400 MPa was obtained at second tests series (Fig. 7, b). By increased stress up to δ_{-1} = 440 MPa the conventional blades were fractured at different cycles number and mainly on distance of 2-3 mm from root blade. The microstructure in this part of HPC blade was coarse grained as in initial material. It was found that the application of electrical upsetting for production of preforms under precise isothermal forging of blades increases the fatigue strength to δ_{-1} = 520 MPa or about 30 % compared to conventional technology produced by hot extrusion followed hot rolling of preforms of HPC blade. As you can see during HCF testing the stress was lowered about two times then at tension testing. The HPC blades produced by proposed technology have identical fine grained microstructure in all parts of blade. By this, according to technical requirements [18] the HPC blades had to withstand fatigue strength of δ_{-1} = 320 MPa at $2•10^7$ cycles. So that the HPC blades which were produced by proposed technology has increased fatigue stress of δ_{-1} = 520 or ~62 % higher with compare to technical requirements, or ~30 % higher compared to conventional technology. In this study the cycle's number to failure during HCF increased four times.

3.4. X-ray analize for life extension improvement mechanisms study

This mechanism include: a) highest heating rate on GB as the electrical resistance is higher on GB with compare to single crystal (according to Joule-Lenz law); b) highest temperature on GB, lower resistance to deformation (at simple shear stress) as material is softer; high temperature on GB influence the interdiffusion of chemical elements between GB and single crystal; c) solid-solid phase transformations and new grains forming via connection to neighboring grains during Joule heating and at small (~5 %) compression deformation; d) X-ray intensity (XRD-2) was decreased as the grain size was increased during rapid Joule heating with very small deformation (see Fig. 3, a). Simultaneously, at followed severe plastic deformation (see Fig. 1, b, region SPD-II) at simple shear stresses the grains elongation take place in the direction of metal flow and defects on GB confluence three neighboring grains are compressed to zero. Extension of the peaks' half-width (Fig. 3, c) indicates that in the SPD-II zone (Fig. 1, b) under shear stress the smaller crystallites are formed (Fig. 5, c). In this zone is also the grain boundaries enriched by nickel of up to 45.3 wt.% (see Tab. 2 and Fig. 6, a). There was also a slight increase in W and Mo, but the Nb and Fe content was reduced. It is well known that the stress gradient heterogeneity or microstructural heterogeneity if UFG metals can also cause peak broadening [21]. The microstructural heterogeneity formed during EUF can also cause peak broadening (Fig. 3, b). The peak asymmetry will be caused by long-range internal stresses as well as chemical heterogeneity change. The anisotropic deformation during the EUF process can lead to the formation of anisotropic crystallites and, consequently, anisotropic peak broadening. Mechanical properties, high temperature strength and high cyclic fatigue of superalloy depends on inclusions, nanorange defects and non-wetting of grain boundaries and also the chemical content of grain boundaries changes (Ni content on GB was increased) and phase's state stabilization take place [22]. This study also shows that the GB were at diffusion enriched by Ni and defects on confluence of three grains were eliminated. Such process is described in [23, 24]. The tensile strength as well as Young modulus were lightly decreased but elongation was increased up to three times during EUF-treatment. As you can see (Fig. 7, a) the tensile stress was up to two times higher then the stress which was used during HCF testing (Fig. 7, b). As result, the HCF strength was increased from 300 to 560 MPa and life extension for $2 \cdot 10^7$ cycles was increased up to 4 times (see Fig. 7, b). During HCF testing the load was step-by-step increased so that the stress was increased by 40 MPa after testing at fully $2 \cdot 10^7$ cycles. Results revealed that the HPC blades with EUF-treatment of preforms exibited longer HCF life then those of the untreated blades. The improvement in HCF life is mainly attributed to the induced by fast Joule heating on GB to higher temperature then in crystallites. The chemical composition of GB was changed [25] as the Ni-content increased on GB (see Tab. 2). The mechanism of oxigen-induced intergranular fracture reduce the GB energy [26-28] in such way that the crack growth path becomes intergranular along rapid diffusion paths.

Conclusions

Results revealed that the life extension and fatigue improvement mechanisms include: a) microstructural defects on GB liquidating; b) Ni content on GB increasing; c) grains refinement at shear stress at final stage

of processing; d) resistivity to chemical leaching increasing. The HPC blades, produced with EUF treatment of preforms under stamping, exhibited longer HCF life than those of the produced by conventional technology. The increase of blades exploitation properties were received in the results of GB defects and the defects on confluence of three grains were eliminated at rapid Joule heating and shear stress of deformation concurrently. This work concludes: it is sufficient to explain the existence of electric current and shear deformation activated grain boundary motion and chemical content change on grain boundaries. The effect of the EUF is to increase the HCF stress/strength and life extension of HPC blades processed by proposed technology from superalloy EP718E has been proven and discussed by X-ray line-profile analysis of microstructure at different stages of HPC blades manufacturing in industry.

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Social interactions in a virtual learning environment: a focus on group formation strategies[1]

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Abstract

This article deals with different strategies for group development in a virtual learning environment (VLE). For this purpose, we sought to investigate the organization and social interactions of students, during group dynamics that occurred in a distance education course. The methodology used in the research was qualitative and quantitative, with descriptive approach, classified as a case study. For data collection, we used the VLE ROODA communication tools (Forum, Contacts and Social Map), the environmental sociometry tool (Social Map), as well as participant observation and questionnaires. Thus, we analyzed the application of three group-formation strategies: random, chosen by the teacher and free choice. Interaction data categorization occurred within the virtual learning environment and was accomplished through the group development stages suggested by McClure. This study allowed us to determine that all three strategies are efficient for distance education, as long as the right time in class for the application of the strategy by the teacher is observed. This study aimed to elucidate the importance of using group work in distance education, especially for integrating students and enabling a greater number of social interactions in the virtual environment. Thus, the results confirm that the use of formation strategies can be effective for Distance Education, since the development of collective activities depends on cohesion and the mediation of conflicts between members of the group.

Keywords: Social Interactions; Groups; Virtual Learning Evironment.

[1] The data presented is based on the master dissertation presented in the Graduate Program in Education of the Federal University of Rio Grande do Sul.

1. Introduction

His article aims to analyze group development and their interactions in the distance education environment through the perspective of three different formation strategies in a virtual learning environment (VLE). Group work is relevant, because the exchange between the students allows them to grasp subjects more easily than when other teaching forms are used [1]. According to Morigi [3], the use of technology creates and recreates new ways of interaction, new social habits, identities, as well as turning people more sociable within the virtual environment.

An extension course was carried out to follow the formation and development of the groups. The course was offered at the Faculty of Education of the Federal University of Rio Grande do Sul (UFRGS) in Brazil. The target audience for this cur was composed of academics, professors and professionals from various areas. Thus, we sought to investigate the organization and social interactions of students during the group dynamics in this course. Therefore, three different strategies of group formation were used: random, that uses algorithms to perform the grouping; The choice of the teacher, which leads the teacher to analyze the profile of each student; And free choice, which is characterized by the students' decision. These group formation strategies were chosen after a theoretical analysis of the most recurrent strategies in the literature. For this purpose, we sought to investigate the organization and the social interactions of students, during group dynamics in a distance education course, from the perspective of three different formation strategies: random, which uses algorithms to perform the grouping; teacher's choice, which prompts the teacher to analyze each student's profile; and the free choice, which is characterized by the students' decision.

We observed that the progress and technological development are elements that enhance social interactions. In this perspective, Nunes et al. [4] defends that "in the virtual world, which is also an environment where social relationships occur, the prospect of identity is perceived by stances taken face certain situations".

Therefore, this article's objective was to analyze group development and their interactions, using different formation strategies within a virtual learning environment. To diagnose group development, we employed the stages model suggested by McClure [5], who uses this term to describe the trajectory of the groups using their interactions In order to achieve the purpose of research, we adopted the virtual learning environment (VLE) known as the Learning Cooperative Network (Rede Cooperativa de Aprendizagem - ROODA) as virtual application space. A VLE allows the student to interact with the materials and the actors of the DE (teachers, student-tutors). The VLE ROODA has several communication features, such as: Forum, Contacts, Group Log, Chat, and the Social Map feature, which displays through sociometric charts a mapping of all interactions. To analyze group formation and development, we performed an extension course, applying the three formation strategies. Thus, we were able to classify and check the student development through group dynamics in distance education environments.

To understand the construction of this research, we present, bellow, the concepts of group work in educational activities. Social interactions and group development are highlighted, especially in distance education.

2. Distance education: social interactions and group development

Distance education has shown an evolution, especially since the advent of personal computers and their integrations, leading us to conclude that "classroom education cannot meet the lack of necessary infrastructure, due to the characteristics of students, as well as the conditions of time and space, among other factors" [6].

The path traversed by the DE is being transformed and/or adapting itself to new medias, all the way to our current use of the internet. Guarezi [7] points out that distance education is "an evolutionary process that began with the physical separation of people and reached the communication process, including, in the late twentieth century, information technologies".

Communication can be promoted synchronously, i.e. in real time through web conference, or asynchronous when students, teachers and colleagues can establish dialogues at different times, using forums and message boards. According to Behar [8]: "Synchronous discussions allow students to discourse not only about the proposed subject, but also on other topics, which encourages socialization". Regarding asynchronous discussions, he emphasized that "they can be the best way to support the interactivity of a distance education course, as long as the students take responsibility for actively interacting" [8].

According to Moore and Kearsley [9], the distance education system is composed "by all the component processes that operate when there is distance education and teaching. It includes subsystems sources of knowledge, creation, transmission, interaction, learning and management". Interaction is essential to the collectivity, it occurs through reciprocal actions between individuals that are part of a unit, always focused on certain purposes. Thus, it is evident that "only when individuals produce actions that influence one another, that interaction happens, due to impulses or purposes" [10].

In this context, Gómez [12] explains that teaching and learning strategies are determined as a set of actions for teachers or students, seeking to benefit the development of certain skills. So, we understand that teaching and learning in a virtual learning environment (VLE) are inextricably linked to the construction of knowledge. The issue of identifying interaction within a VLE is important for understanding the possibility of analyzing member group development during interactive dynamics.

In short, it is essential to add as an advantage, the growth and social empowerment that occurs through contributions and collaborations within a VLE. At the following section, we highlight the importance of group dynamics in distance education.

2.1 Group Dynamics In Distance Education

The term "group dynamics" will be used in this article as a synonym for group work, since we understand that both are used for interaction and engaging individuals within a group. The concept of group dynamics is part of the social psychology, considered a science that studies the nature and performance of groups, through interactions and interpersonal relationships among its members [11].

Minicucci [10] points out that group dynamics "emerged as the convergence of certain trends in the social sciences, when they started investing in the study of new technologies for solving social problems [...]" [13]. It focuses on examining the nature (or structure) of small groups, their functioning, as well as their method of development, phenomena and the principles that govern them.

The individual can acquire information by himself or by participating in multiple networks and groups, as long as they share the same interests, ideas, values, have no temporal, institutional or geographic restrictions [14]. For this, the individual need to appropriate the technological resources for collaboration and interaction, along with some practical group dynamics, used in classroom courses. Davis [1] argues that individuals learn to work in groups to solve real problems, gaining experience in collaborative learning. Catapan [13] points out that distance education differs from the traditional mode by the way the pedagogical mediation is established.

There is a substantial difference in how teaching is conducted in the face-to-face method and the distance education. In person, there is the possibility of diagnosing developments, problems and difficulties in real time of events and, then, make immediate adjustments in how the methodology is applied. In the distance education, the creation of methods and tools for these purposes is essential [15]. Similarly, the psychological and emotional issues are naturally identified, while virtually difficult to observe. In this context, another conflicting factor is the process of selecting and grouping individuals, who require an adjustment to the environment to include the establishment of criteria (participants' profile, necessary heterogeneity, etc.), seeking to assist in the formation of the group [16].

Performing group dynamics in distance education courses, is directly influenced by the relevant changes in three main areas of social life: "the scope of production/consumption (economy), the scope of power (political) and the scope of everyday experience (society/culture)" [12]. The author argues that these "confluences of such significant and radical changes, are shaping a new meta-context that modifies institutions, States and the daily life of citizens within an era of globalization and interdependence".

In this scenario, we perceive that individuals are increasingly submerged within an accelerated pace of change and, consequently, are influenced by the communications and information technologies, especially in relation to society and education [6].

Valentini and Soares [16] highlight that educators perform group dynamics without having the knowledge of the variables involved in the formation and development of these groups. The authors also point out that, factors like affinity among students stands out during the formation, even without the participation of all.

The transformations in socialization panoramas are directly affected by changes in relationships, both of power and of the production of individuals, particularly in the current context of digital information [14]. The author further states about the current social scenario that the subjects are confronted with "a climate of insecurity, uncertainty and fear, both as possibilities, aspirations and unforeseen opportunities", very different from those taught by family.

In this scenario, the next section underlies the different strategies and their applications, followed by the explanation regarding group development when faced with different types of formation.

2.2 Group Formation Strategies

Studies focused on group practices in virtual environments, analyze the "complexity of the combining personal skills, existing forms of communication; the importance of interaction; the roles that individuals take within the groups and the types of tasks to be performed" [19]. Therefore, it is within this approach that this article exists, through the observation and monitoring of group development within a virtual

environment.

What affects group dynamics the most, especially in DE, is the teachers' reluctance, especially in defining and pedagogically grounded parameters to form groups [19]. From the subject described by the author, we emphasize that the strategy is used to establish pathways, action plans that must be traversed to reach the end result of a scheduled challenge.

According to Lima and Webber [17], it is important to consider that the Distance Education intensifies the complexity of group formation, since we have a physical separation of the members, diversity in communication, as well as the choice of the best technique and technological apparatus. Usually in group dynamics, we consider only the practice of collaboration, without taking into account the structural features of this collaboration.

This study aimed to analyze the social interactions among group members in different contexts and to collect data regarding group development, using different ways of grouping people. Thus, from a research on the ways of grouping people, it has been identified that there are three recurrent strategies in the scientific litera-ture. The main strategies used were pointed out by Davis [19] and contemplate three possibilities that can be applied in the distance modality. Bellow, we have the group formation strategies, according to Davis [19].

•Random – is defined by an algorithm, automatically. Thus, it is considered the most democratic of strategies;

•Free – it is the most liberal, since it allows for the stu-dent to choose, with whom he or she wants to work. Thus, there is a risk of segregation, though it may also be motivating;

•Teacher – it is the most controlling, since the educa-tor analyzes the student's choice and sets up groups that are most balanced and just; however, there is the risk of demotivation.

Still according to Davis [19], the number of members may influence the time it takes to achieve the tasks. The author claims that to form groups of four or five mem-bers is ideal. However, the less time there is, available to perform the tasks, the smaller the group should be.

For all members to be involved in group works, it is important for members to have affinity of ideas, as well as similar values and understandings about the subject they have been given. Thus, we stresses the need to un-derstand how strategies influence group development

2.3 Classification Of Group Development

This article had as a basis the stage model suggested by McClure [5] to identify the structural development of groups. The author proposes a model with seven stages, which are: pre-formation, unity, disunity, conflict-confrontation, disharmony, harmony and execution. This author points out that there is a decline towards the conflict-confrontation stage, which is the bottom apex, following a constant rise towards execution (see Figure 1).

Figure 1. Arc of a group's stages in social. Source: Autor et al (2018). Adapted from McClure (2005, p.80).

The model is represented by a symmetrical arch, where each stage on one side is the exact opposite of the next on the other side. What the members dispose at each stage during the descent, shown on the left side (from the Pre-formation to the Conflict-Confrontation), they win back in the corresponding stage during the ascent (right side). According to McClure, the movement of the stages displayed in the arc shows in the descent a random oscillation, while the ascent, individuals have voluntary control of their movement [5].

Progress through the stages is uneven, with advances and setbacks, but the overall movement of the group is progressive. The transitions between the phases occur by discontinuous leaps and nonlinear and unorganized transformations. Each stage in the arch is a higher level of organization. Success in each stage is necessary for the group to reach its full potential.

Regarding McClure's [5] arc, he also adds that at each stage is a movement of spiral forces. These forces arise from the need of satisfying the interests of individual members of a group. The author shows these needs juxtaposing them against the global forces that are represented by: safety, association, dependence, independence, privacy and risk-taking. Thus, in the stages of development, each of the group's tasks can be seen as a satisfying the central issue.

This work used group development analysis, from the social networks point of view, through sociometric charts that are provided by the Social Map, within the virtual learning environment ROODA. This is a feature that aims to portray, through charts, the diagnosis of the subjects' social interactions in the courses and disciplines that use this VLE. Currently, this tool is in the testing and validation phase, thus available only for the teacher to use. In this perspective, we can identify connections, influences and existing priorities within a group. The feature is in the testing phase, and we expect that it will be available to the academic community at the end of 2016.

Given these assumptions, the next section has the methodology and the research steps performed in this study.

3. Research Methodology

O meet the proposed objective in this research, we developed a qualitative and quantitative research, with a descriptive approach, a case study. The subjects were students, teachers and professionals from various fields, who participated in a Management extension course.

The methodology was divided into three steps:

• STEP 1 - Theoretical Study - a survey of theoretical concepts and constructs were initially developed, allowing the related topics to be understood and known in depth.

• STEP 2 - Pilot Project This stage began with the participant observation of the researcher in an undergraduate course at a University in Brazil. The students (total of eight) were undergraduate courses from the University. The data were collected in the Forum and Social Map of VLE ROODA. In VLE ROODA, the students' social interactions were also observed. The data made it possible to identify some difficulties encountered by the participants in relation to the group formation and, thus, to observe which strategies of group formation the teacher used during the discipline. These data enabled the mapping and improvement of group formation strategies. The pilot project provided an analysis of group formation, with the application of the three suggested strategies: 1) free choice; 2) random; 3) choice by the teacher. The pilot study provided some information regarding strategies that were very important to consolidate the research trajectory. The relevance of this investigation occurred from the difficulty of students to organize and interact collaboratively for the good of the work group;

• STEP 3 - Extension Course - The course provided an extensive range of important data to support this research. The functionalities of the VLE ROODA used were: Classes, Contacts, Forum, Chat, Webfolio, InterROODA, Logbook, A2 and Social Map. For each strategy of group formation used, a specific forum was set up social panels between the participants. For the evaluation of the course, the social interaction between the students in the VLE ROODA functionalities and the application of a final questionnaire, with open and closed questions, was considered. The data collected allowed an analysis of each strategy of group formation delineated in step 2.

For data collection, we used different techniques to gather information and register the elements. The instruments used in this research were: the ROODA functionalities (Group Forum, Forum, Contacts, Chat, Group Log, Group Diary, InterRooda and Social Map); Questionnaires (at the beginning and end of the course) and participant observations of the researcher.

For the purpose of a quantitative research, data collected were organized in spreadsheets, tables and charts submitted to exploratory analysis of the questionnaires. For the qualitative diagnosis, we used the stages described by Moraes [20]: preparation, unitarization, categorization, description and interpretation. The analysis of group development used the seven stages of structural development proposed by McClure[5], previously described: pre-formation, unity, disunity, conflict-confrontation, disharmony, harmony and execution.

Having the necessary information, out next step was to organize and analyzed the data

4. Data discussion and analysis

He course held in step 3, entitled "The Art of Managing: application in everyday life", allowed data collection about the formation strategies and group development. We chose analysis activities and solutions to challenges presentation. The pedagogical proposal consisted, therefore, of group dynamics with the same level of difficulty and likeness for each group formation strategy used.

The subjects that participated in the research were students, teachers and professionals from different areas. In all, 40 people participated in the study, of which 27 were female (67%) and 13 were male (33%). The age range varied from 17 to 50 years, with 37% between 17-26 years, 45% between 27-36 years and 18% between 37-50 years. The profile of the participants pointed out that the students that accept to study in the distance modality are adapting to new realities of the society, especially linked to the digital technologies. Thus, it is important to constantly analyze the interactions within virtual learning environments to apply strategies that can facilitate the formation of groups in distance education.

Participants also pointed out that there are some aspects that can help in the development of the group in distance education: communication, exchange of ideas and experiences (34%); Collaboration, participation, dedication and commitment (23%); Division of labor (23%). These data corroborate authors such as Behar[8], Davis [1] [19] who stress the importance of group dynamics for educational practices.

The subjects who participated in the survey were students, teachers and professionals from various fields, with 27 female participants (67%) and 13 male (33%). Age ranged from 17 to 50 years of age, with 37% between 17-26 years, 45% between 27-36 years and 18% between 37-50 years. Through the participants' profile, we observed that students who accept studying in distance education have been adapting to new realities of society, especially linked to digital technologies. Thus, it is important to constantly analyze the interactions within the virtual learning environments, to apply dynamics that facilitate group formation in distance education.

Besides a profile survey, students understand the aspects that facilitate group work, since they highlighted as relevant and pertinent points in the context of interaction: communication, exchange of ideas and experiences (34%); collaboration, participation, dedication and commitment (23%); division of labor (23%). Data regarding distance education experiences corroborate other items collected on the subject analysis profile and demonstrate the importance of group dynamics in educational practices.

Seeking to systematically present the trajectory of group development, we designed tables to summarize and expose this construction. Groups were analyzed separately, following what occurred in the extension course.

The first strategy adopted was the random, enabling participants to have a first contact, since not everyone knew each other. The second was the teacher's choice, to group students with the same interests. The third strategy was the free choice, giving the students more responsibilities within the groups. Thus, after the first week, which was reserved to get to know the VLE ROODA and the presentations of the members in the forum, we began implementing the group formation strategies.

4.1 Group Formation Strategies: Interaction Analysis

This section presents the results observed through group analysis, using the three strategies applied in the

extension course.

4.1.1 Random strategy

In the overall analysis of the random strategy for creating groups, we observed that some of the factors that caused difficulties were that the students did not know each other, did not master the VLE ROODA platform and most had never participle in distance education courses before. Thus, we realized that working in groups during this strategy was a challenge. Participants who exceeded the insecurity barrier created by these factors accomplished excellence in their works. We found that, of the ten groups formed, only one obeyed the seven stages suggested by McClure [5] in an orderly and linear fashion (Group A), the other nine groups walked through the stages in a disorderly manner. We would like to highlight that, since there were many groups, we chose Group A (table1) to represent this strategy in the detailed analysis of the development phase, since it was the most complete.

GROUP A		
McClure STAGES	**Extracts from the Group's Forum**	**Analysis**
Pre-formation	"Good night, everyone! I want to check with you how we're going to organize ourselves to do the tasks. We could each post our visions about the cases and continue interacting through the forum. I propose that on 05/31 we could schedule a time to chat and discuss the best solution for the cases and and formalize the finishing of the weeks activities. Regarding putting the material together, I offer myself to do it. What do you think?" (Student 46).	At this stage, the leader (Student 46), organized the group, determined the structure, and found an appropriate environment.
Unity	"Hiiii, guys... Could we divide the work into parts.. And I agree with Student 46 of scheduling a time for us to talk... If anyone wants to share their numbers, it also helps..." (Student 28)	The members worry about the survival of the group, producing dependence regarding the leader.
Disunity	"I think that diving the work would end up leaving us with a limited view on each case" (Student 46).	At this stage, we have the first conflict and the suggestion of ways to go.
Conflict-confrontation	"But we could created several scenarios to line up the group work and then each posts their idea and then we interact. And, anyway, we have three cases and 4 group members. I finished reading the material today and I intend to start the activities tomorrow. What do you think?" (Student 46) "I think it is a good idea for each one to post their idea" (Student 24)	We verified a search for balance.
Disharmony	"You are right, Student 46, of each one sharing their ideas. My answers to the questions are similar to those of student 24. I have a doubt regarding the	Here we have an agreement despite differences and diversities between

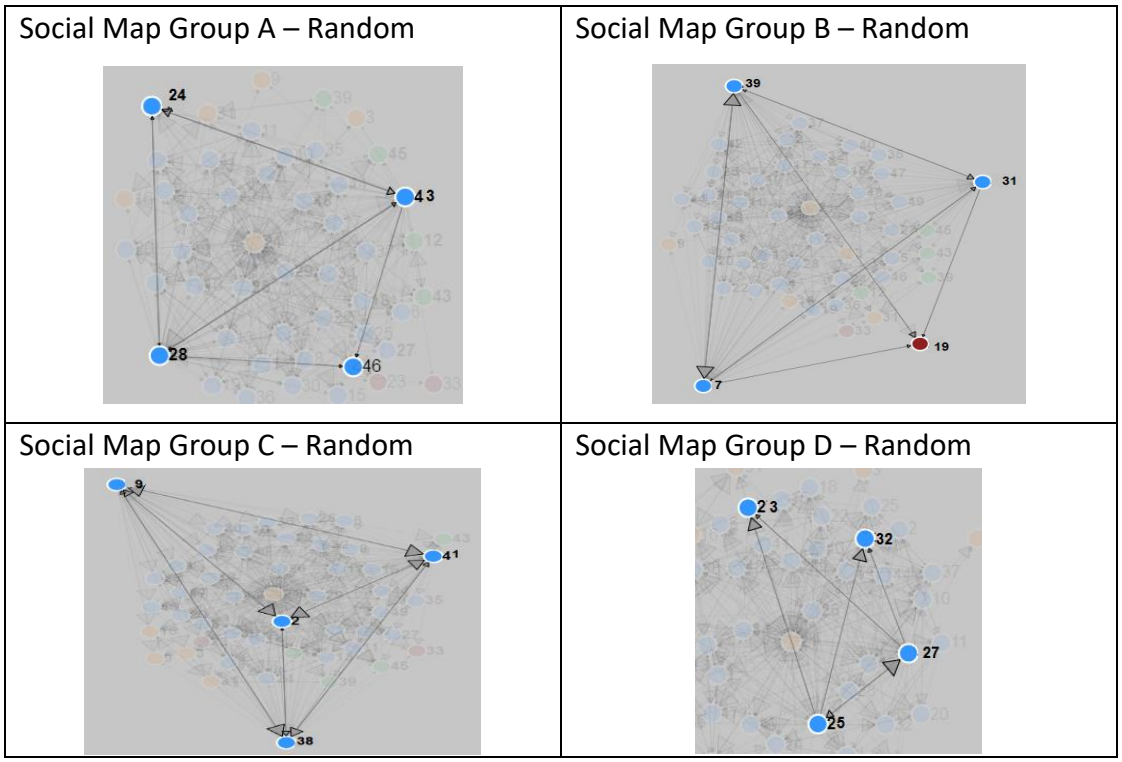
	presentation? Do we have to create a background scene? I didn't really understand it..." (Student 28).	members.
Harmony	"hiii guys I caught the idea of our colleague regarding the first case. what do you think? I accept suggestions... I tried to create a scenario..." (Student 28) "hiii Student 46, I think it looks good..." (Student 25).	We see that differences were overcome and social norms were established.
7.Execution	"Colleagues, according to what we talked about, I posted the final work presentation at the Webfolio" (Student 46).	At this final stage of the arc, which is characterizes by productivity, we have the posting of the final work.

Table 1. Analysis of Group A of the Random Strategy.

According to Palloff and Pratt[15], with the understanding of group dynamics, educators have more opportunities to organize their classes.

To have an overview of the interactions in the random strategy, we analyzed the interaction maps of the groups (see Figure. 2).

Considering the interaction of a person or a group, exemplified by their connections, we have the strong and weak ties within a group context. According to Recuero [21], the "[...] transformations, in a social network, are largely influenced by the interactions".



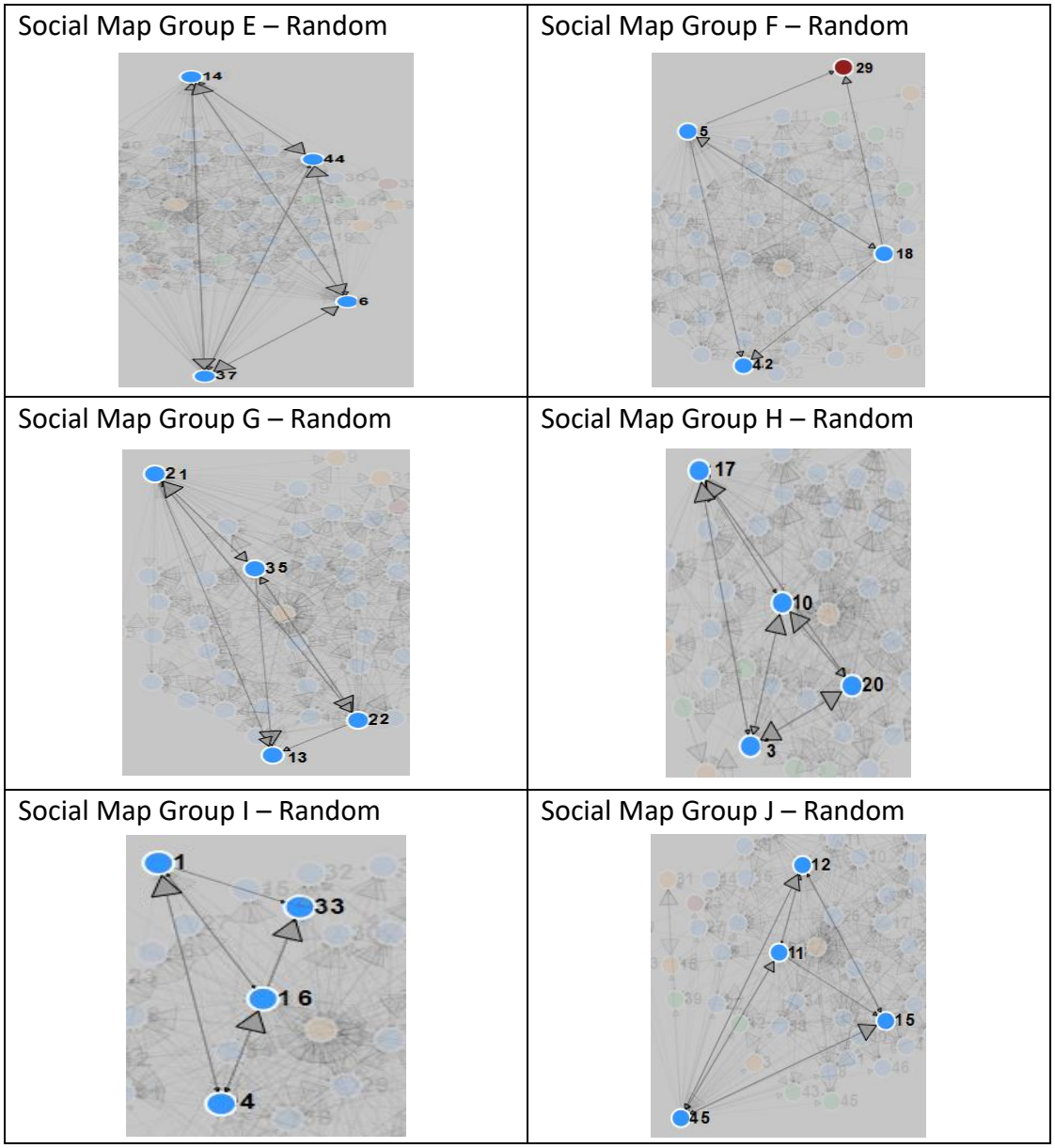


Figure. 2. Group maps of the random strategy.

Several authors, such as Barabási [22] and Recuero[21], recognize the importance of social relationships and student interactions for a good performance in the activities developed in the educational context. Similarly, Moreno [23] and McClure [4] point out the importance of socialization for a group to have good coexistence. In accordance with these authors, it is believed that the understanding of interpersonal relationships, as well as its structure and the position that individuals occupy within it, help educators in their teaching activities.

In this perspective, we see that the random strategy created groups that successfully performed the requested task, even when faced with some difficulties

4.1.2 Teacher's choice strategy

The second strategy was the teacher's choice, where the teacher used the presentation and also an analysis of each student from the previous activity to create groups. In the end, we had 9 groups. Below, we have a

summary of Group G (table 2), displaying the influence of the context and the participation of students in performing each tasks.

GROUP G		
McClure STAGES	**Extracts of the Group's Forum**	**Analysis**
Unity	"Good morning for everyone on the group, we have to schedule a day to discuss the work, who has the time can post their ideas. Hugs." (Student 22) ... Hello, guys, this is the week's activity, I hope we can talk on the weekend to discuss out trip. Hug." (Student 22)	Demonstrated the participant's anxiety regarding the activity's execution.
6. Harmony	"After the initial definitions we established, I'll be available to share the first few slides of our presentation, if you agree, in PPT." (Student 6) ... "Perfect, Student 6, I'll be waiting to add straight to the slides." (Student 22)	We observed the group overcoming their differences and established social norms and the feeling of belonging.
1.Preformation	"Hello Student 22, good night. On the previous post, you suggested the Caribbean as a destination and I agree with this option, but we still need Student 45's opinion to move forward with the work. I suggest dividing the tasks to makes things quicker. I can save a ppt file and each one of us can add some content. Student 22, could you research the places and put together travel itinerary for a 15 day trip?" Hugs." (Student 6)	The leader (Student 6), determined the tasks and structured the work.
6. Harmony	"I don't know if you guys imagined it like I did, but if you agree with it, we could add Tuesday the content's checklist to slide 3 and the description of the itinerary to slide 4." (Student 6) ... "Yes, this information is important and I intended to include them on the Checklist slide. And I also think that in a more direct way, with the data and information highlighted somehow to be conferred/checked by the family members whenever necessary. Agreed?" (Student 6)	Indicated a feeling of mutual respect in the group.
5. Disharmony	"Hello colleagues, Yesterday I post some things at the forum, saved another file on the Webfolio and sent some messages through "Contacts" letting you know all this, however, I received no answer regarding our work. Please, let me know if you will be participating of this	Demonstrated a conflict caused by the yearning for equal effort from all members in favor of the group.

	work's completion. Hugs." (Student 6) ... "I'm sorry, yesterday I couldn't view anything. What exactly is missing? Regarding the summary of subjects, only viable if we remove the explanation of the places." (Student 22) "Student 22, I tried to get in touch with you tonight using the A2 but unfortunately I couldn't view you. I'm sorry, but considering the late hour, I won't remain ROODA anymore for today. [...] so, this i show it's going down, I'll draw up 03 slides with possible hotel in Aruba, to make the research more appealing, since we won't be able to decide today anyway which hotel we'll use, we waited too long for the decision of our third colleague, and it seems she hasn't had a lot of time for this task.."(Student 6)	
6. Harmony	"... Since I had to add to this task, I apologize for some misunderstanding or lack of participation, and thank you for your understanding. A big hug and good luck with the other assignments" (Student 22).	They recaptured the feeling of mutual respect.
7. Execution	"Yes, I think the work turned out good. Though we had different views regarding content and form of presentation (texts, data and others), I believe the result is satisfactory" (Student 6).	The posting of the final work as requested was considered the execution.

Table 2. Group G Analysis of the Choice Strategy by the Teacher

Due to evasions, Group G was left with only three members. It achieved all seven stages, but in a totally disorganized way, starting with the unit that is the stage of anxiety and then returning to the harmony stage three times before execution. Despite the divergences between students 6 and 22, and the withdrawal of student 46, the group delivered the requested activity on time.

According to McClure[5], through group works, members tend to change, evolve and mature due to the interactions they had between them. Analyzing the teacher's choice strategy, we identified through the final questionnaire that most students liked the groups created, since members with common interests were brought together. Also, with it being a strategy that provided productive work, we demonstrated the importance of analyzing each student's characteristics before grouping them.

To supplement the data on the teacher's choice strategy, we present below an overview of the groups (see Figure 3).

Social Map Group A – The Teacher's Choice	Social Map Group B – The Teacher's Choice	Social Map Group C – The Teacher's Choice

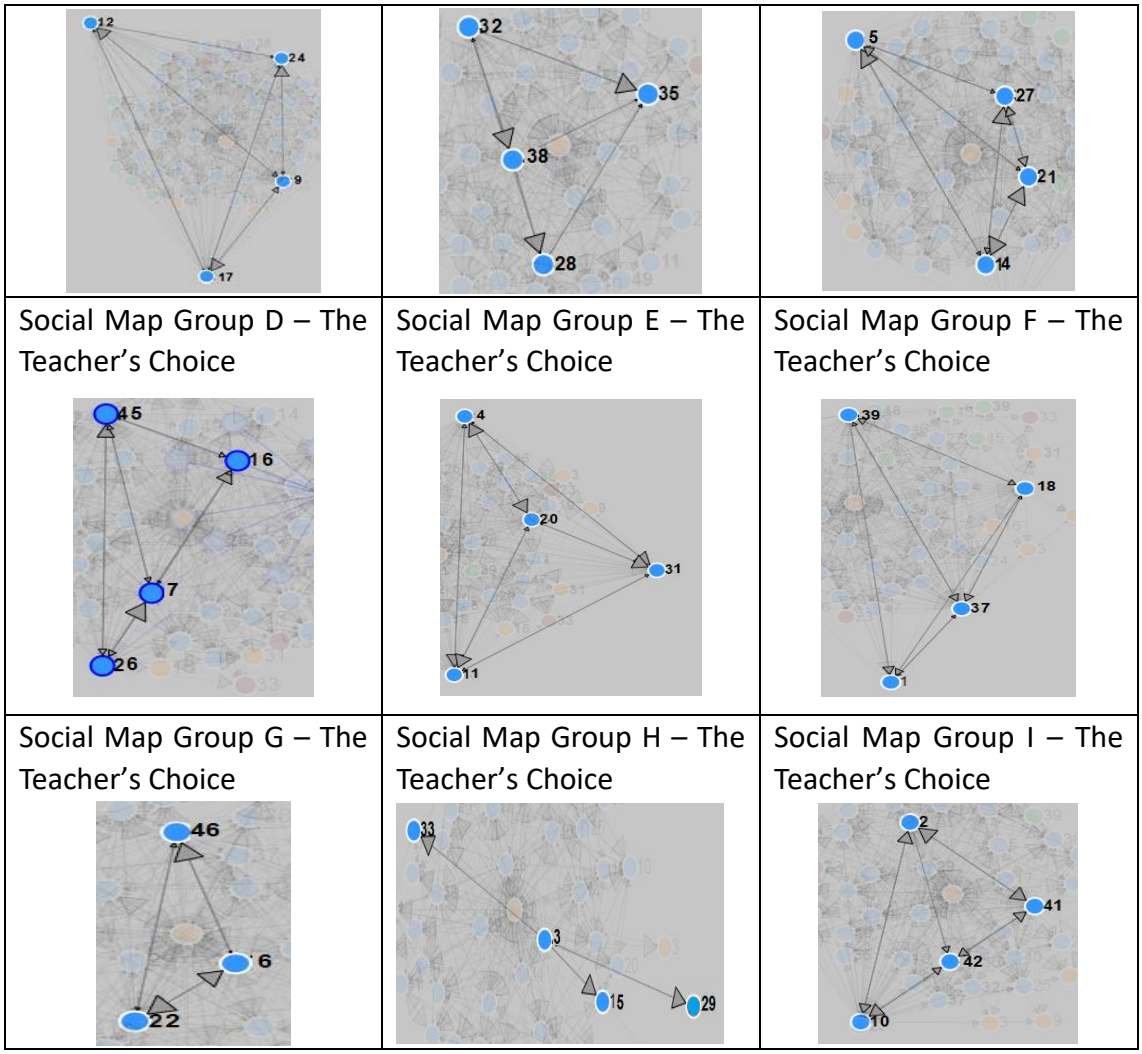


Figure. 3. Group maps of the teacher's choice strategy.

Analyzing the maps with the first strategy, we see a substantial increase in the interactions of this second activity. Connections are more intense and ties are stronger. Through this perspective, Recuero [21] points out that "a social network requires the actors, who are part of this network, to engage in a process of cooperation. Without cooperation, there is no group".

Thus, we can understand group movement along all stages. In this context, McClure[5] emphasizes the importance of divergence for group development and explains that progressive growth in these collective activities, cannot be viewed as linear or one-dimensional. Each stage has its peculiarities and, therefore, all stages must be performed in an orderly fashion, seeking to demonstrate a linear evolution of the group. In the next section, we have the description of the free choice strategy.

4.1.3 Free choice strategy

The free choice strategy created 9 groups, with one group not interacting at all within the forum, but posting the final work. The other 8 groups interacted more effectively in this strategy and – like the previous one –, there was no group that failed to complete all seven stages. There were some disagreements, but without arguments. To better grasp this, we have some extracts of the Group A (table 3) bellow. This group was selected as an example for analysis, because they had a better evolution than the rest.

GROUP A		
McClure STAGES	**Extracts from the Group Forum**	**Analysis**
Pre-formation	"Hi guys. How are your schedules for this week?" (Student 20) ... "Hello Student 20, I usually log in to ROODA at noon and at night" (Student 6) ... "could we settle then at night. Like during the day is complicated for me. I saw that we have to plan an event!" (Student 3)	They started by finding an appropriated environment to ensure interaction between members.
Unity	"Colleagues, I agree that at night we could settle the first interactions regarding our work, division of labor, etc. for next monday. What do you think?" (Student 6) ... "ok, tomorrow at what time? 20,21h? xx. I'll try to read all the material before and write down some ideas." (Student 3)	Demonstrated concern with the progress of the activities.
6. Harmony	"I really liked Student 3's idea, totally what I was thinking" (Student 6)	We verified the feeling of belonging to the group, for having ideas in common.
5. Conflict-confrontation	Hi girls, I agree with the summary of what you said and congratulations for the impulse! ... I already copied the summary posted and I suggest we divide the topics into four, each one develops it and then we share. Regarding our next meeting, I'm available. How and when is best for you guys? Who knows, at the chatroom like Student 3 did yesterday! (Student 6)	We identified the leader's capacity (Student 6) of propelling the group forward.
6. Harmony	"I copied bellow again the script for you guys to review, now with some extras that I put according to the suggestions posted. I added from the item 8 on and some things about the part 2 of the activities." (Student 6) ... "If you guys want, I can put the ppt together and then you add the background, I can do this today	The establishment of social norms and mutual respect between the members.

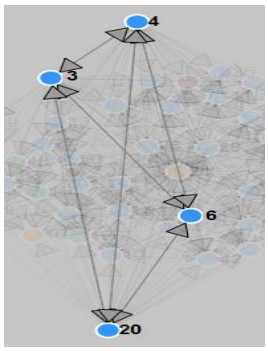
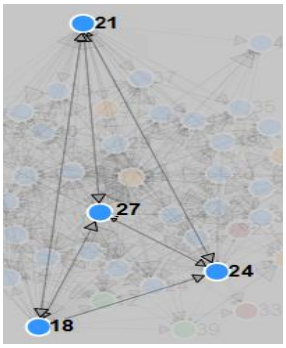
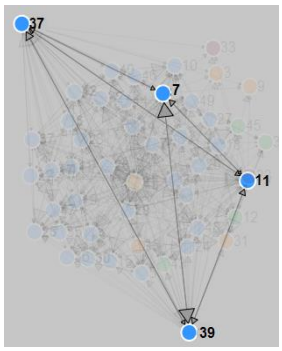
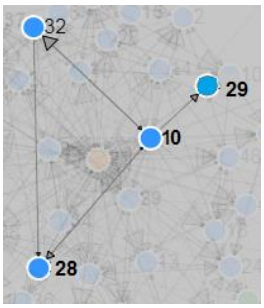
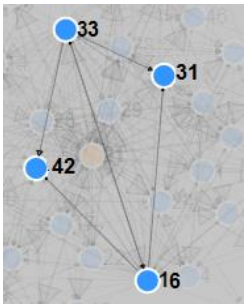
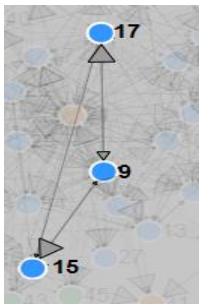
	at night and send it to you guys tomorrow morning. However, I need your approval." (Student 20)	
7. Execution	"I take this opportunity to thank for the partnership. It was great sharing the work's activities with you." (Student 6) ... "It was a pleasure working with you guys" (Student 20)	The posting of the final work was considered execution.

Table 3. Analysis of Group A of the Free Strategy

In the analysis of the free choice strategy, group members had more affinities, causing less conflict and contributing to the use of other communication resources outside the ROODA platform, which meant a decrease in the amount of interactions performed within the VLE.

Recuero [21] points out that "conflict can be highly beneficial to strengthen the groups, but can also disrupt the groups and lead to their rupture".

To clarify group development in the free choice strategy, we have the panorama bellow, built using group maps (see Figure 4).

Social Map Group A – The Free Choice 	Social Map Group B – The Free Choice 	Social Map Group C – The Free Choice 
Social Map Group D – The Free Choice 	Social Map Group E – The Free Choice 	Social Map Group F – The Free Choice 
Social Map Group G – The Free Choice	Social Map Group H – The Free Choice	Social Map Group I – The Free Choice

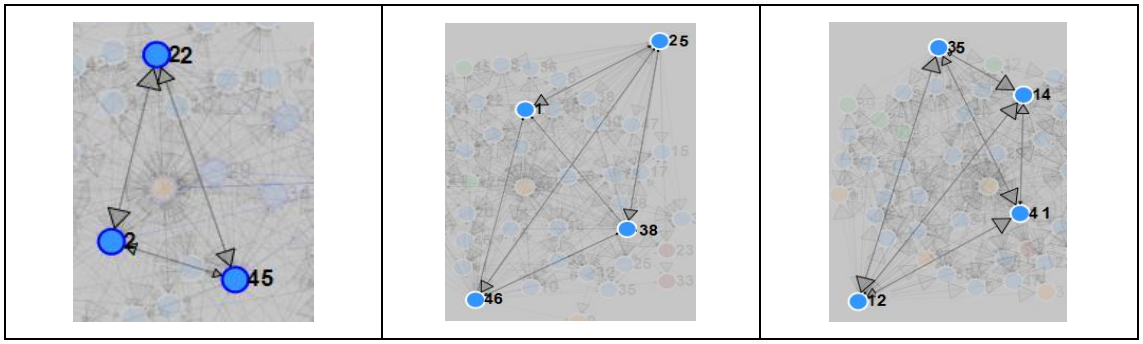


Figure. 4. Group maps of the free choice strategy.

These infographs show members interactions according to the evolution of each group. Group members had more affinities, causing less conflict and contributing to other communication resources, thus decreasing the amount of interaction they had within the VLE ROODA, for they focused on other communication tools such as instant messenger.

It is noteworthy in this strategy, the harmonious work performed by the groups, characterizing the affinity and homogeneity of opinions reflected in the groups' development. In the development analysis, all groups were non-linear, unlike other strategies groups, more cohesive and dynamic. In this context, we understand that the students working in these groups develop greater abilities solving problems and better assimilating the studied material.

For group development, we must understand that participants are independent people and that they need to be in an environment considered safe to collaborate with others for the sake of performing the requested tasks. This study was important to analyze the feasibility of creating effective groups in distance education, using a virtual learning environment, in this case, ROODA. Bellow we have our final considerations.

5. Final considerations

Pon completing this study, we considered it possible to map and classify group development using McClure's[5] stages, identifying how groups work when faced with different formation strategies in a virtual learning environment.

Palloff and Pratt [15] point out that "McClure sees group development as chaotic and self-organized. Thus, the movement between stages is not linear", and from this finding, we understand the trajectory of the stages.

Regarding group formation, we defined these strategies as more pertinent to this research: random, using algorithms to determine groups; teacher's choice, which seeks to analyze each student's profile, and free choice, which is defined by the students' decision.

Soon, we found that group development only occurs when individuals feel safe, embraced by their colleagues and having everyone committed to efficiently performing the activities. Similarly, students need to see that they are a part of the group and can trust their colleagues. Thus, they are able to create stronger ties and interaction, taking a stronger stance towards the completing the work.

For these reasons, strategy analysis allow for data collection, seeking to assist educators with group dynamics in distance education. Following the analysis of the interactions, verified from the results of the

forums and also of the sociograms, it is highlighted as suggestions of educational activities the educator's reflection on the following aspects:

•plan each step of the group work, which includes deciding on each dynamic and how to use them;

•organize the topics, to address the interests of each participant, thus keeping them motivated and interested;

•provide feedback to the groups, while they perform the proposed activities, so the members do not feel abandoned by the teacher;

•assess, in addition to the work submitted, the interaction of these in the development of the groups;

•request role definition, with division of labor, as an evaluative question, so that students are actually able to plan how they will perform each task;

•determine at the beginning of class that any evasion should be notified to the group and to the teacher, so the group is not harmed by the absence.

•planning educational interventions in groups that have a non-collaborating member, so the group does not loose motivation due to the lack of participation by some colleagues.

We consider it noteworthy that the subjects acted differently when faced with each context. Thus, we understand that there are several ways to apply these strategies, only then supplementing with other results. So, we understand that this study is not conclusive, though the results can be used by teachers as a means of analyzing the application possibilities of group dynamic exercises, especially in distance education.

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Efficiency of fungicide chemical group in the preventive and curative control of *Puccinia sorghi* in corn and *Cercospora zeae-maydis* sporulation in different culture media

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ABSTRACT
The chemical control of diseases is one of the most used measures, especially for a rapid and precise control. The objectives of this work were to verify the behavior of three chemical groups of fungicides applied in a preventive and curative way aiming the control of common corn rust and the sporulation of Cercospora zeae-maydis in different culture media. Two experiments were installed, one for chemical control and the other for sporulation. For the chemical control experiment, propiconazole, azoxystrobin, ciproconazole + azoxystrobin and benzovindiflupir + azoxystrobin were the fungicides preventively and curatively applied for the control of common corn rust in a random block experimental design with three replicates. In relation to cercosporiosis sporulation experiment, five culture media were used: potato sucrose agar (PSA), V8 agar juice (V8), (LCHA), corn leaf extract (CL) and seasoned tomato extract (STE) were used. Discs with Mycelial of the fungus were placed on the media and submitted to the 12-hour light/12-hour dark continuous dark in a double factorial (culture media and light treatments) experimental design with four replicates. The fungicides azoxystrobin and ciproconazole + azoxystrobin were efficient for up to 21 days after inoculation of P. sorghi, the fungicide azoxystrobin was efficient for the curative control of P. sorghi. The greatest sporulation of the fungus was verified in the medium with seasoned tomato extract submitted to the photoperiod.

Key words: Cercosporiosis; Chemical control; Common rust; Conidia.

1. Introduction

Corn (*Zea mays* L.) is grown in all parts of the planet, and the world's largest producers are the United States, China and Brazil, which ranks the third place with a current average production of approximately 88.9 million tons (Conab 2018). The productivity of this crop is affected by several factors, among which, the diseases, which cause great losses, impairing the development and reducing the photosynthetic area, inhibiting the translocation of assimilates from the source of production to the areas of growth and deposition of yield material (Gomes et al. 2011).

Among the diseases that occur in corn, common rust and cercosporiosis stand out. Common rust has *Puccinia sorghi* Schw. as its etiological agent and deserves attention because it is classified among the

main foliar diseases in the corn crop, which can cause direct damage to the plant by reducing the photosynthetic area, which can culminate in a reduction in grain yield (Von Pinho et al. 1999). In many cases chemical control of plant diseases is the only efficient and economically feasible measure capable of ensuring high productivity and quality of production. The use of fungicides is more intense in the most economically developed countries, where agriculture uses more advanced technology, greater application of inputs and prospects for better harvests. The application of fungicides in corn crop has shown maintenance of crop productivity since chemical products control efficiently when correctly applied (Lago and Nunes 2008).

The triazole fungicides group, named demethylation inhibitors (DMI), acts on the pathogen by inhibiting the C-14 demethylation reaction (Linhares and Ghini 2001). Strobilurins interfere in mitochondrial respiration, blocking the transfer of electrons through the cytochrome bc1 complex, through the inhibition of ubihydroquinonacytochrome c oxidase reductase (Ghini and Kimati 2000). Cytochromes are ferroproteins that act sequentially, transferring electrons from CoQH2 to molecular oxygen. The interference exerted by the fungicide prevents energy release and ATP formation (Forcelini et al. 2001).

Carboxamide, the last chemical group to be launched in the market, has high systemicity and a wide spectrum of action in ascomycetes, basidiomycetes and deuteromycetes (mitosporic), adding consistency in the control residual. In addition, they exhibit protective and curative action, even controlling resistant pathogens to strobilurins. These indicate a possible effect on the biosynthesis of proteins, lipids, DNA and RNA, in addition to a greater transformation of glucose or acetate into succinate and a decrease in the transformation of citrate, malate and fumarate. The use of mixtures with fungicides with different mode of action increases the fungus control spectrum, the residual period of applications and helps to avoid the development of the sensitivity reduction of the fungus to the fungicide (Reis et al. 2010).

The fungicides present protective, eradicating, curative and anti-sporulating action. The protective action is expressed when it is applied before the pathogen infects the tissues of the plant. The curative action consists in the ability of the fungicide to limit the development of the pathogen inside the tissues, when applied in the latent period, that is, in the interval between the penetration and the appearance of the first symptoms. Among the factors that may influence the curative action of a fungicide, host susceptibility, disease pressure, meteorological conditions and the moment of application of the fungicide in the plant stand out (Genet et al., 2000). Factors such as syrup volume, number and interval of applications and the application technology used may directly infer on the protection potential of a fungicide (Töfoli 2006). So, the knowledge of the action of each chemical group is important as it may interfere with the control efficiency in the field.

Another important disease is cercosporiosis, which has fungus *Cercospora zeae-maydis* Tehon & E.Y. Daniels 1925 as its etiological agent. According to Ward *et al*. (1993), the disease is able to reduce grain production by 20 to 60%, depending on the susceptibility of the corn hybrid. This disease has caused significant losses in the major corn producing regions in the Brazilian crops in 2000 and 2001, no longer being considered secondary and becoming part of the most important diseases in corn crop (Pereira et al., 2005). One of the greatest difficulties is the sporulation of this fungus in laboratory for later inoculation in plants for research works.

The composition of the culture medium determines the mycelial growth and the sporulation of phytopathogens. Most fungi require a source of carbon and nitrogen, as well as other elements at lower amount, such as potassium, phosphorus, sulfur, iron, magnesium, zinc, manganese and vitamins. Carbon is the most important element for the development of the fungus, since it is essential for the synthesis of enzymes besides being the main source of energy. Nitrogen is a fundamental part of amino acids, which in turn makes up proteins, which can be from organic sources such as casein and peptone or from inorganic sources, such as sodium and potassium nitrate (Alfenas and Mafia 2007).

In addition to the components of the culture medium, another factor that interferes with the development of pathogens is the light treatment. According to Teixeira et al. (2001), light can induce, inhibit or have a neutral effect on fungal growth and sporulation. Light stimulates asexual and sexual reproduction in most fungi, and light-sensitive fungi spores when exposed to this condition, but others require a period in the dark or continuous dark to initiate sporulation.

The objectives of this work were to verify the behavior of different chemical groups of fungicides when applied in a preventive and curative way aiming to control the common rust in corn and to determine the sporulation of *Cercospora zeae-maydis* in different culture media, submitted to light treatments, 12-hour-light/ 12 -hours dark photoperiod and continuous dark.

2. Material and methods

The experiments were conducted in Laboratório de Fitopatologia and in a greenhouse at Faculdade de Agronomia e Medicina Veterinária at Universidade de Passo Fundo, Passo Fundo-RS, Brazil.

2.1 Experiment 1 – Preventive application of different chemical groups for *Puccinia sorghi* control

Plant growing and fungicide application

The hybrid Pioneer 30F53, susceptible to common rust was sown in pots with 10 kg of horticultural soil, and kept in greenhouse with 12-hour photoperiod. Three plants per pot were used. When plants reached the V4 stage (fourth expanded leaf with visible collar, ligula and auricle) (RITCHIE, 1993), they were sprayed with the different treatments (Table 1) using CO_2 pressurized backpack spray, calibrated for syrup volumes of 100 L/ha.

Table 1. Fungicides used for *Puccinia sorghi* control in corn.

Commercial name	Chemical group	Active ingredient	Dose [3] [4] (g a.i. /ha)	Dose [3] [4] (L or kg p.c/ha)
Tilt	Triazole	Propiconazole	100	0,4
Priori	Strobilurin	Azoxystrobin	75	0,3
Priori Xtra[1]	Triazole + Strobilurin	Ciproconazole + azoxystrobin	24 + 60	0,3

Elatus[1]	Carboxamide + Strobilurin	Benzovindiflupir + azoxystrobin	30 + 60	0,2

[1]Adjuvant added Nimbus 600 mL/ha; [2]Active ingredient. [3]Commercial product;

Inoculum production and plant inoculation

The inoculum was multiplied in hybrid Pioneer 30F53 plants and kept in greenhouse for later application. For the preparation of the suspension, leaves with intense sporulation were collected and placed in a container for agitation with water and polyoxyethylenesorbitane spreader (Tween 20) for spore release. Then, the spores were quantified in a Neubauer chamber (Alfenas and Mafia 2007), and the suspension was calibrated to $20x10^3$ spores / mL.

The plants were inoculated with the fungus *Puccinia sorghi* and then covered with plastic bags for 24 hours to maintain leaf wetness. The inoculated leaves were marked with permanent marker for later identification, because only the leaves that received fungicide were evaluated. Inoculations were done on days 1, 4, 7, 10, 15 and 21 after application of the fungicides (Table 1).

Evaluations

After 30 days of inoculation, the marked leaves were collected and the severity and number of uredia/cm^2 were evaluated. For the severity, the leaf area attacked by the disease was estimated and severity scores from 0 to 100% were assigned based on severity data. Based on severity data, control efficiency was evaluated using the ABBOT formula (1925) (Efficiency (E%) = (severity of the control - severity of the treated plot) / severity of the control * 100).

For the number of uredia/cm^2, a circular area of 0.81 cm^2 of each leaf was extracted with two replicates per leaf, and the uredia were counted with the aid of a magnifying glass. The experimental design was a randomized block design with four replications, each replicate was composed of a plot with three plants.

2.2 Experiment 2 – Fungicide curative application for *Puccinia sorghi* control

The Pioneer 30F53 hybrid corn susceptible to common rust was sown in a pot with 10 kg of horticulture soil and kept in a greenhouse in a 12-hour photoperiod. When the plants reached the V4 stage, they were sprayed with the same fungicides from the previous experiment (Table 1); the applications were carried out on days 1, 3, 6, 9, 13, 16 and 20 after inoculation of the plants with the fungus, using O_2 pressurized backpack sprayer, calibrated for 100 L/ha syrup volumes.

Inoculum multiplication, inoculation and incubation of the plants and evaluations were performed using the same procedures for the preventive application experiment with this same fungus.

Firstly, the fungus was inoculated and then the fungicides were applied, and after thirty days, the evaluations mentioned in experiment 1 were carried out with preventive application of fungicides to control this fungus. The design was a randomized block design with four replications.

2.3 Experiment 3 –*Cercospora zeae-maydis* sporulation

The experiment was carried out in the Phytopathology Laboratory and in a growth climatized chamber at Faculdade de Agronomia e Medicina Veterinária at the University of Passo Fundo, Passo Fundo/RS/Brazil. The isolates of *C. zeae-maydis* were grown in V8 culture medium (Tuite, 1969). After the monosporic isolation, different culture media were evaluated in order to determine the best sporulation of the fungus, which were: 1) potato sucrose agar - PSA (Tuite 1969): (200 g potato extract, 20 g dextrose and 16 g agar and water up to reach 1000 ml); 2) V8 juice agar (19) - (200 ml of Campbell Soup Co. V8 vegetable juice, 16 g agar, 3.2 g CaCO3 and 800 ml distilled water); 3) lactose casein hydrolyzed agar - LCHA (19): in 2000-ml Erlemeyer, the following were added: i) 3 g/L hydrolyzed casein; ii) 10 g/l agar; iii) lactose 37.5 g/L; iv) $MgSO_4.7H_20$ 0,5 g/L; v) $ZnSO_4.7H_20$ 0,43 g/L, vi) $MnSO_4.4H_2O$ 0,2 g/L, vii) $Fe(NO_3)3.9H_2O$ 0,72 g/L, at a final volume of 1000 mL, after the dilution, the pH was corrected to 6; 4) Corn leaf extract - CL (1): (80 g chopped corn leaf extract and heated until boiling, 16 g agar and water up to 1000 mL); 5) seasoned tomato juice - STJ (Tuite, 1969): 200 mL of Super Bom® tomato juice; 16 g agar; 3.2 g $CaCO_3$, 0.2 g streptomycin and 800 ml distilled water.

After the preparation, the culture media were autoclaved at 121°C for 20 minutes and aseptically poured into polyethylene petri dishes (60 x 15 mm). Thereafter, eight plates were prepared for each of the culture media. In the center of each plate, a 4.68 mm diameter mycelial disc of the fungus grown for twenty-five days was deposited in PSA culture medium (Tuite, 1969). Then, four plates of each medium were submitted to the photoperiod (12 hours of light and 12 hours of dark) and the continuous dark. Treatments were randomly assigned to the growth chamber with OSRAM® Universal 40-watt fluorescent lamps at 25°C for 25 days. After that, the sporulation was quantified, so 5 mL of distilled water were added to the petri dish and with the help of a brush, the conidia were removed. From this suspension, 1 mL was collected, and then the number of conidia counted in Neubauer-type hemacytometer (Alfenas & Mafia, 2007). The number of conidia.cm^{-2} was calculated on the basis of number of conidia.mL^{-1}.

The experimental design was completely randomized with a 5 x 2 double factorial arrangement (culture medium x light regimes) with four replicates. The number of conidia.cm^{-2} was submitted to analysis of variance and the means were compared by the test of Tukey at a 5% probability of error. The Assistat software was used in this experiment.

4. Results and discussion

4.1 Fungicide preventive application for *Puccinia sorghi* control

Twenty-one days after fungicide application, the fungicides benzovindiflupir + azoxystrobin (mixture of carboxamide and strobilurin) and ciproconazole + azoxystrobin (mixture of triazole and strobilurin) showed the lowest value for this variable and control of 90.99% and 80.81% respectively. For the number of uredia/cm^2, the benzovindiflupir + azoxystrobin and ciproconazole + azoxystrobin presented the lowest values and control of 86.25% and 76.34%, respectively (Table 3).

For *P. sorghi* severity, it was verified that the fungicide benzovindiflupyr + azoxystrobin presented a 15-day residual whereas the fungicide propiconazole (triazole) showed an 18-day residual. The fungicides azoxystrobin and cyproconazole + azoxystrobin, the chemical group of strobilurins and mixture with

triazole were efficient for up to 21 days after inoculation (Figure 1A). When the number of uredia.cm^2 was evaluated, all the fungicides but fungicide propiconazole presented control of the disease (Figure 1B).

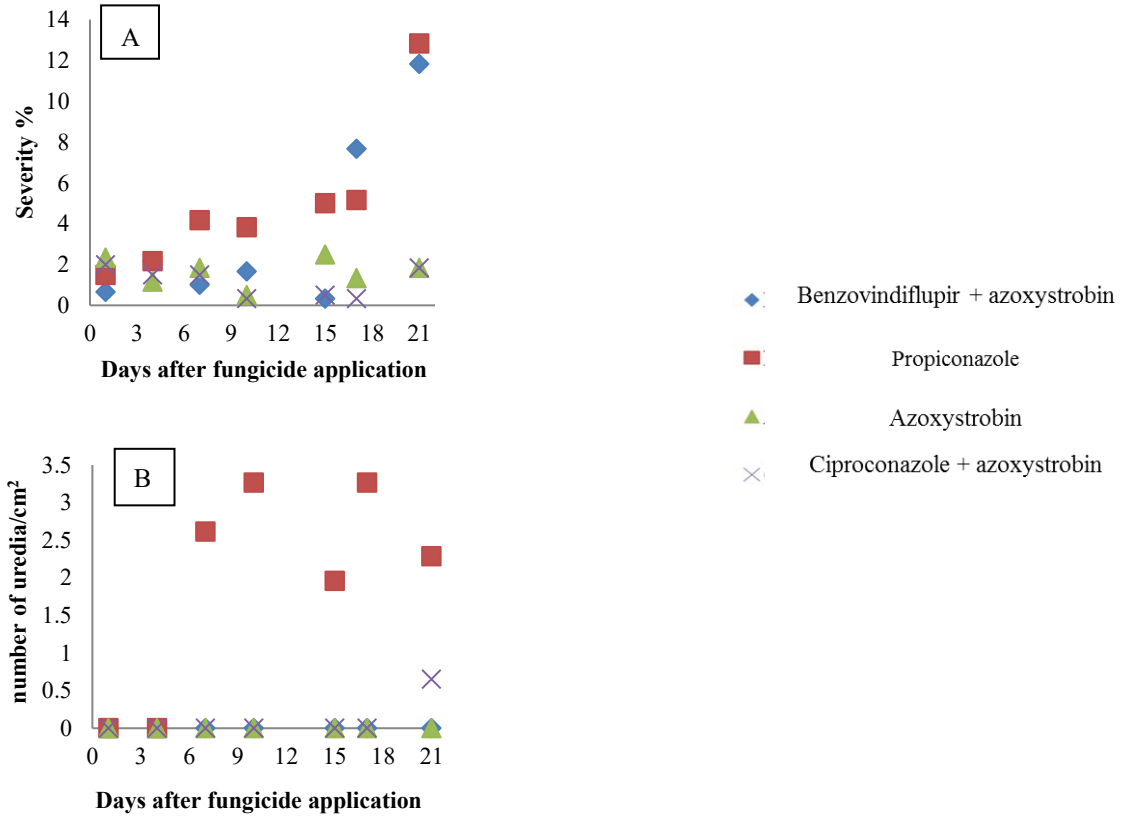

Figure 1. Severity (%) (A) and number of uredia.cm^2 (B) relationship in the interval in days between fungicide preventive application and Puccinia *sorghi* inoculation in the corn.

Table 3. Severity, number of uredia and spores produced per cm² of leaf area 21 days after fungicide preventive application to *Puccinia sorghi* control.

Fungicide	Severity (%)	Control (%)	Number of uredia /cm²	Control (%)
Control	20.33 a[1]	-	19.28 a	-
Propiconazole	12.83 b	36.98	13.76 b	28.62
Benzovindiflupir+ azoxystrobin	1.83 c	90.99	2.65 c	86.25
Azoxystrobin	11.83 b	41.81	14.23 b	26.19
Ciproconazole + azoxystrobin	3.90 c	80.81	4.56 c	76.34
CV (%)	15.6		17.0	

[1]Means followed by the same letter are not different from each other by the test of Tukey at 5% probability.

4.2 Fungicide curative application for *Puccinia sorghi* control

In the curative applications of disease severity, it was observed that all the fungicides showed efficient control until 16 days after inoculation of the fungus. Twenty days after inoculation, the fungicide propiconazole (triazole) showed an increase in disease severity (Figure 2A). For the number of uredia.cm^2 and number of spores.cm^2 at 16 days after inoculation, the fungicides propiconazole (triazole) and benzovindiflupyr + azoxystrobin (mixture of carboxamide and strobilurin) showed the greatest values for these variables (Figure 2B).

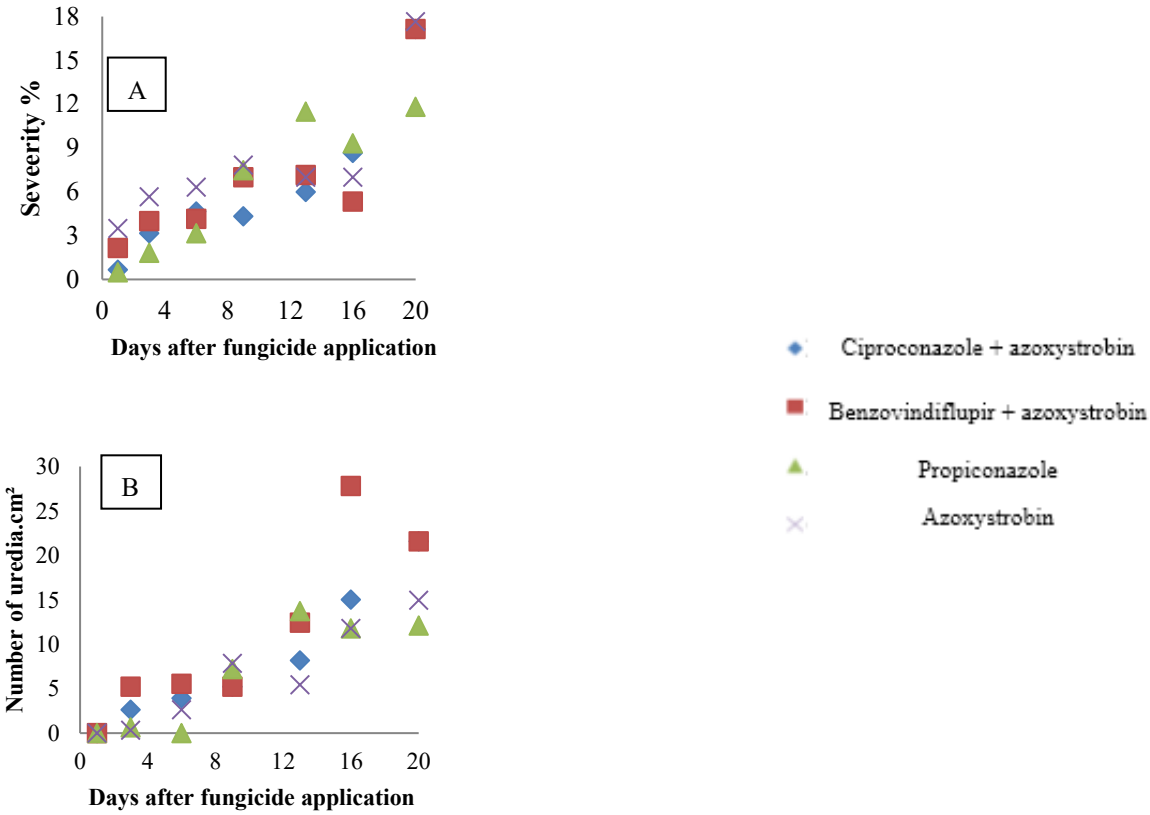

Figure 2. Severity (%) (A) and number of uredia.cm^2 (B) relationship in day intervals between *Puccinia sorghi* corn inoculation and application of the different fungicides.

For severity and number of uredia/cm^2 of *P. sorghi* at 20 days after fungicide application, all treatments were greater than control with values ranging from 41.68% to 51.50% (Table 4).

Table 4. Estimated severity, number of uredia and spores produced per cm² leaf area 20 days after fungicide curative application for *Puccinia sorghi* control.

Fungicide	Severity %	Control (%)	Number of uredia /cm²	Control (%)
Control	32.29 a	-	31.45 a	-
Ciproconazole + azoxystrobin	17.16 b	46.86	20.56 b	34.63
Benzovindiflupir + azoxystrobin	17.00 b	47.35	20.01 b	36.38
Propiconazole	15.66 b	51.50	18.09 b	42.48
Azoxystrobin	18.83 b	41.68	20.94 b	33.42
CV (%)	23.56		9.98	

[1]Means followed by the same letter are not different from each other by the test of Tukey at 5% probability level.

Chemical control is one of the chief methods for controlling plant diseases, both for ease of use and for the results obtained. However, its constant indiscriminate use may promote the selection of resistant fungi, putting at risk the efficiency of the method. This is undesirable to the chemical industry, to the producers and to the consumers, as approached by Ghini and Kimati (2000).

According to Boller et al. (2007) the effectiveness of the control depends on the age of the infection. A fungicide application on newly established infections results in the death of the pathogen. Azevedo (2007) reports the curative/eradicating effect in most crops is most pronounced of fungicides up to 48 to 72 hours after infection of the pathogen. In older infections (longer than half latent period), the energy no longer used for growth is reallocated to reproduction, causing wounds and forming spores, viable or not. This process lasts for three to four days, sometimes more if the air temperature is low. At first sight, this fact surprises the farmer, who perceives more wounds after the application of the fungicide and may interpret it as a failure in the control. The cause, however, is the high number of non-visible infections at the incubation stage, which reinforces the need to an earlier application, preventively or when the first symptoms appear, at the very most (Boller et al. 2007).

When applied for the control of other patossystems such as the yellow spot in wheat, fungicides are efficient only when applied in the first days after infection. After 10 or 12 days, the action of the fungicide no longer influences the existing infections (Ranzi and Forcelini 2013). Similar results were obtained by Menegon et al. (2005) with leaf spot on barley. This fact reinforces the importance of the moment to start the application of fungicides, as already pointed out by Reis and Casa (2007), as one of the factors that most affects the effectiveness of chemical control of diseases, emphasizing that the application of fungicides should be preventive or, at the most, right after the initial symptoms were detected.

Works on fungicides that evidence the control of P. sorghi are scarce in the literature. It was only found for other rust species. Godoy and Canteri (2004), when testing the effect of fungicides also verified that the application at two days after the inoculation of *P. pachyrhizi* reduced the amount of infections,

however, it did not act on the eradication. Azevedo (2007), on the other hand, reports that the curative and eradicating effect of systemic fungicides is more pronounced in the first 48 to 72 hours after pathogen infection. Ugalde (2005) believes that this behavior is attributable to the inhibition of foliar tissue colonization, or even a fungistatic effect upon uredinospores.

The triazoles are more systemic, which gives a characteristic of greater mobility, occupying the sites that are infected or more quickly susceptible of infection. Whereas strobilurins present a slower systemic action, a property that confers greater residue and, therefore, greater efficiency in preventive applications (Hewitt 1998).

According to Vieiro (2008), in the wheat leaf rust patosssystem, the triazole + strobilurin mixture presented better performance, especially in relation to the number of spores formed in each wound, which evidences two aspects: a lower sensitivity of the fungus to the triazole fungicides and an anti-sporulating action of strobilurin.

4.3 *Cercospora zeae-maydis sporulation*

Regarding the culture media, a significant interaction (Table 6) occurred. The largest sporulations of the fungus *C. zeae-maydis* were in media V8, PSA and LCHA, which were statistically equal among each other, regardless of the light regime. The STE medium presented a greater value in the photoperiod, as well as CL in the continuous dark, and no statistical difference was found between them. The lowest values were for the CL medium in the photoperiod and STE in the continuous dark. In addition, they were statistically inferior to the other media.

For the light treatments, when the plates with culture media were submitted to the photoperiod, the STE medium presented greater fungus sporulation, statistically differing from the other media, whereas the smaller sporulations were in the CL and LCHA media, which were statistically inferior to the others. For the continuous dark, the highest sporulations were in the STE, V8, PSA and CL media, all of them statistically superior to the LCHA, which presented the lowest sporulation.

Table 6. Sporulation of *Cercospora zeae-maydis* in different culture media and light regimes.

Culture medium	**Sporulation (conidia.cm^{-2})**	
	Photoperiod [1]	**Dark [2]**
Seasoned tomato extract (STE)	A 1153.0 a[3]	B 154.5 a
V8 juice agar (V8)	A 174.2 b	A 80.7 a
Potato sucrose agar (PSA)	A 109.2 b	A 52.1 a
Corn leaf extract (CL)	B 19.6 c	A 170.3 a
Lactose casein hydrolysate agar (LCHA)	A 17.7 c	A 9.8 b
CV (%)	13.92	

[1]Photoperiod: 12 hours of light and 12 hours in dark.

[2]Continuous dark.

[3]Means followed by the same lower-case letter in the column and upper-case letter on the row are not different from each other by the test of Tuckey at 5% error probability.

Sporulation of *Cercospora* species in culture medium is difficult and experiments where abundant sporulation has been *in vitro* induced (Calpouzos 1954) are scarce. One of the characteristics of this genus is the slow growth and scarcity of sporulation in artificial media. According to some authors, the V8 culture medium is reported as good sporulation inducer in several species of the genus *Cercospora* (Beckman and Payne 1983; Brunelli et al., 2006; Hanada 2002). This medium presents higher nutritional richness and greater amount of complex carbohydrates (Tehon and Daniels 1925), and these characteristics promotes sporulation of mitosporic fungi (Lukens 1963). The STE which is a variation of V8 and was also cited as a proper sporulant for *Passalora sojina* (Hara) H.D. Shin & U. Braun 1996) (Camera et al. 2014), *C. zeae-maydis* (Brunelli 2006) and *Cercospora nicotianae* Ellis & Everh (Queiroz and Menezes 2009). In addition, STE can be a more economical alternative as tomato is available in the local market and is a product of easy access and domestic production, besides its practicality.

Castro and Coelho (2000) verified that *Cercospora* conidia production did not start on day five, with sporulation peak occurring on the eighth day of incubation under continuous light treatment in Carrot-Dextrose-Agar medium. According to Koshikumo (2011), the culture medium PSA provided a greater sporulation of *Cercospora*.

Regarding the genus *Cercospora,* there are reports indicating the positive effect of light on fungal sporulation, as well as on light and dark alternating treatments, which is verified for *Cercospora arachidicola* Hori (Moraes and Salgado 1997), *C. zeae-maydis* (Beckman and Payne 1983), *Cercospora kikuchii* (Matsumoto and Tomoyasu) Gardner] (Dela-Cueva 1995) and *P. sojina* (Camera et al., 2014). Total or partial inhibition of sporulation under continuous dark conditions is also observed for *Cercospora nicotianae* Ellis & Everh and *Cercospora arachidicola* Hori (Kilpatrick and Johnson 1956; Stavely and Nimmo 1969).

According to Brunelli (2006), only the V8 and STE media induced abundant sporulation of *C. zeae-maydis*, both in the photoperiod and under the sequential light treatment (144 h light and 72 h dark). In addition, a small number of conidiophores were produced in PSA, but not of conidia, and for CL and CL with CaCO3, no formation of these structures occurred. Numerically speaking, the STE medium provides smaller growth in different species of *Cercospora* and explains that it is a medium with greater nutritional richness, containing vitamins, amino acids and other nutrients that stimulate spore production, which starts at the edges of colonies, and inhibits mycelial growth.

It was verified in the present work that the sporulation of the fungus *C. zeae-maydis* is related both to the composition of the culture medium and to the light regime, since the STE medium presented higher sporulation when the plates were submitted to photoperiod and lower in the continuous dark; kowever, this pathogen presents low sporulation when compared to other fungus genotypes.

5. Conclusions

The fungicides benzovindiflupir + azoxystrobin of the carboxamides + strobilurins chemical group and cyproconazole + azoxystrobin from the chemical group of triazoles + strobilurins present satisfactory control in preventive applications for the control of *P. sorghi*.

For curative control of P. sorghi, the fungicides ciproconazole + azoxystrobin, benzovindiflupir + azoxystrobin, propiconazole and azoxystrobin do not present satisfactory control at 21 days after inoculation of the fungus. So, these fungicides must always be used in in a preventive way, that is, they should be applied before the entry of disease in the field.

The greatest sporulation of *C. zee-maydis* is verified in tomato juice medium (STE) in the 12-hour light/12-hour dark photoperiod. In addition, this medium can be used in further studies with this pathogen.

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Consumption Experience of Impulse Buying in Algeria

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Abstract

This article focuses on impulsive buying experience. It aims at exploring whether the explanatory variables of this type of purchase, which are used in the marketing literature in the West, may account for the impulsive buying behavior in the Algerian cultural context. An extensive literature review allowed clarifying the basic concepts of this research; it led, firstly, to determine the variables that stimulate the consumer emotions and arouse pure impulse purchase and its consequences, and secondly, to show its importance to producers and distributors. The empirical study was conducted on 590 buyers from the Wilaya (Province) of Tlemcen (Algeria). The results of the data analysis, using the software R, indicate that the variables used in this study have a better predictive power of achieving the favorable experience of impulse buying.

Keywords: Shopping experience, Impulse buying tendency, Hedonic buying, Algerian consumer

Introduction

Since the late 1970s, and especially starting from the year 1990, consumer behavior has evolved significantly towards a strong and real reassessment of the affective and emotional dimension in the act of purchase (Filser, 1996). The analysis of the purchasing decision process must no longer consider the consumer as a rational machine to process signals (price, design, quality, availability, etc) in order to maximize its utility, but rather as "*a person seeking experiences that can provide social connections and hedonic rewards* "(Holbrook, 1999). Nowadays, the consumer is not only considered as a rational human being but as an emotionally empowered individual who tries to make sense of his consumption (Giraud, 2000; Bessouh et al , 2015). He is always looking for the unexpected; he would like to be surprised by the offers proposed by companies. Executives have understood the issue as they try to play more and more on these dimensions. Their principles are based on transforming the act of purchase into experience. It is important to know that it is the affective dimension that explains why the consumer is sensitive to all that is unexpected (Piron, 1991; Akram et al, 2018). Everyone agrees on the fact that the need to make economic rationality coexist with emotional irrationality appears more and more in the consumer's behavior. Indeed, in his act of purchase, the individual is guided by a rational economic calculation, through which the technical characteristics of the offer and its price are evaluated and compared, but also through a sensitivity of his own that unconsciously teleguides him towards offers involving an emotional dimension. Many

studies have repeatedly demonstrated the influence of the affect on attitude and behavior. Moreover, recent years have highlighted and emphasized the predominant role of emotion which is seen as "*a facilitator of decision-making, on the one hand, and an essential regulator of behavior, on the other*" (Pillet, 1969; Mggoldrick, 1999). Thus, many researchers have acknowledged that emotion is one of the most important factors that can influence the consumer's responses to marketing stimuli. In a more global manner, one can assert that the experiential paradigm makes it possible to explain behaviors that would appear irrational in a cognitive approach. This naturally led us to focus on impulse buying as part of an experiential approach Rook, 1987).

1. The impulse buying experience - Current state of research

According to the distinction suggested by H. Stern (1962), the impulsive buying experience refers to emotional impulse purchasing, and/or to pure impulse buying. According to D. Rook (1987), who is considered as the main founder of this research stream, impulse buying is experienced by the consumer as an often striking emotional and cognitive experience. Impulses come in special circumstances, depending on whether the consumer is in a bad mood or in a good mood, whether he has money or not, whether the products are on sale or not, or whether he comes alone to the store or accompanied (Leblanc Maridor, 1989; Beatty and Ferrell, 1998; Youn and Faber, 2000). Impulse buying is closely related to experiential consumption which is generally accompanied by emotional responses. Therefore, the main objective of studying impulse buying as part of the impulse buying experience is to understand the sequence of affective, cognitive and sensory reactions that lead to impulse buying. Thus, not taking into account the emotional experience that tinges the impulsive experience is, however, a major limitation in understanding impulsive behavior through the cognitive approach. At this level of analysis, impulse purchasing can be defined by affective components, and the experience of impulse purchasing may be conceived as part of decisions that are influenced by conscious subjective aspect of feeling or emotion.

2. Definition of the impulse buying experience

Specifically, only the affective approach seems to have an explanatory scope of impulsive buying. Rook (1987) was the first to give an impulsive purchasing definition that is mainly based on impulse. For this same author, "*There is impulse when the consumer feels an irresistible desire to buy something immediately. This impulse is quite complex at the hedonic level and can give rise to emotional conflicts. In addition, it often takes place with a diminished consideration of the consequences".*

O'Guinn and Faber (1989) define impulse buying as *"The inability to master an irresistible urge to buy. The latter permeates their lives and the results are significantly important; sometimes it has serious consequences*" (p. 147).

- For Rook and Gardner (1993), impulse buying occurs either to prolong a happy mood, or to comfort a person in a bad mood.

According to Piron F. (1993), impulse purchase is generally accompanied by strong emotional and/or cognitive reactions. It responds to a sudden and strong desire to buy something.

- Moreover, Leblanc-Maridor (1989) defines impulse buying as a purchase made by an individual when he is happier or more depressed than usual.
- According to Puri (1996), emotional impulse buying is "*A sudden event in which the purchase decision is made immediately, with no prior intention to buy*". For him, impulse purchase occurs when the consumer feels a strong desire to buy; this action tends to be spontaneous and without much thought. In addition, Puri suggests that "*Impulse*" is the result of choosing an option that offers immediate hedonic benefits but serious long-term consequences.
- For Haussman (2000), impulsive purchase is strongly linked to emotions experienced at the point-of-sale. Similarly for Giraud (2002) who indicates that impulse buying is an eminently emotional behavior. The purchase is made in response to an impulse. Giraud says that the store's environment spurs the consumer to make an impulse purchase.

3. Purchase impulses and impulsive buying at the point-of-sale

A purchase impulse is defined as "*A sudden and powerful desire to buy something immediately*" (Rook, 1987). Impulse buying is a purchase made in response to such an impulse. A consumer plagued by the purchase impulse is overwhelmed by a desire so powerful that it tends to dominate his judgmental abilities and annihilate his capacities to resist. Products bought impulsively are often superfluous but the desire felt by the consumer is such that he is willing to pay, sometimes a high price, to get them. Impulse purchases are lucrative and therefore financially attractive for producers and distributors. Therefore, the concept of impulsive behavior in marketing and psychology (Hoch and Loewenstein, 1991) allows highlighting the fact that an impulse occurs when the consumer projects himself into a buying and consuming experience and then anticipates a sufficiently strong emotional benefit so that the idea of not yielding to one's desire, and also of not having access to that gratification, is frustrating.

Impulse purchases may therefore be related to the characteristics of the buyers, i.e. level of impulsiveness, personal control, etc. (Rook and Hoch, 1985; Youn, 2000), of the product, i.e. low price, hedonic potential, etc. (McGoldrick, 1999; Youn and Faber, 2000), of the point-of-sale atmosphere (Spies et al., 1997). Impulse purchases may also be due to situational factors, such as mood, time pressure, crowd, etc. (Betty and Ferrel, 1998; Lichtlé and Plichon, 20015). Resisting a buying impulse requires a high level of personal control. It will be all the more difficult to resist an impulse of purchase that this impulse is powerful or that the consumer feels several successive impulses for different products when he is at the point-of-sale. Impulse is a driving force or emotion that triggers the emotional impulse buying. Therefore, the following strategic question is worth examining in this article: *How can signs, clues or icons stimulate purchase impulses?*

Stone's research (1954) is one of the main and founding references in this field. This author identified four purchasing orientations that constitute attributes that he himself favors; these are the search for low prices, different facets and practicality, time saving, and a purchase seen as a constraint that one seeks to avoid (the apathetic buyer). Tauber (1972) initiated this axis of research by analyzing the comments of thirty men and women about their shopping activity. It is widely accepted that emerging motivations are of social nature (encounters, co-presence, meeting people and being in public, sharing a common interest, etc.),

and/or of personal nature (breaking out of the daily routine, self-gratification, etc.). These are some of the reasons for frequenting a shopping place (see table1).

Table1 : Atmospheric variables (Turley & Milliman 2000)

External variables	General interior variables	Layout and design variables	Point of purchase and decoration variables	Human variables
Exterior signs	Flooring and carpeting	Space design and allocation	Point-of-purchase displays	Employee characteristics
Entrances	Color schemes	Placement of merchandise	Signs and cards	Employeer uniforms
Exterior display windows	Lighting	Grouping of merchandise	Wall decorations	crowding
Height of building	Music	Work station placement	Degrees and certificates	Customer chracteristics
Size of building	P.A. usage	Placement of equipment	Pictures	privacy
Color of building	Scents	Pacement of cash registers	Artwork	
Surrounding stores	Tabacco smoke	Waiting areas	Product displays	
Lawns and gardens	Width of aisles	Waiting rooms	Usage instructions	
Address and location	Wall composition	Departement locations	Price displays	
Architectural style	Paint and wallpapaer	Traffic flow	Teletext	
Surounding areas	Ceiling composition	Racks and cases		
Parking availability	Merchandise	Waiting cues		
Congestion and traffic	Temperature	Furniture		
Exterior walls	cleanliness	Dead areas		

4. Empirical analysis

Referring to the works of Belk (1975), Rook (1987), Haussman (1991) and Giraud (2002), it is found that the store's environmental factors are important stimuli that are capable of triggering the desire to buy impulsively. For this reason, this study attempts to determine the link between impulse buying and the store variables. However, after the description of our investigation, a preliminary analysis of the data is carried out, and then a presentation of the link between the point-of-sale environment and the impulse purchase is made.

4.1. Research methodology

In order to test the hypotheses proposed in this research, a field study was conducted among 590 individuals who visited the clothing stores (Men / Women) located in the center of the city of Tlemcen. The questionnaire was administered in times when no special sales or discounts were offered. Our sample was chosen based on the fact that these stores pay particular attention to the physical environment. Note that the physical environment and the global atmosphere within the store are two explanatory variables of our research.

4.2. Survey results

The first descriptive results of our survey will be presented later.

4.2.1. Socio-demographic variables

The socio-demographic portrait of the buyers in our sample is presented in this section, through different variables, namely gender, age, educational level, income level, family situation and occupation.

Gender	Percentage
Woman	56.36%
Man	43.63%
Age	
Under 25	22.86%
Between 25 and 34	28.83%
Between 35 and 44	23.64%
Between 45 and 54	16.88%
Between 55 and 64	4.67%
Between 65 and 74	2.6%
Over 74	0.52%
Income	
Less than 18000 Algerian Dinars	10.65%
From 18000 to 21001 AD	34.55%
From 21001 to 35000 AD	27.53%

From 355001 to 50000 AD	16.1%
From 50001to 70000 AD	10.39%
More than 70000 AD	0.78%
Family situation	
Single	63.12%
Married	31.43%
Divorced	4.42%
Widow (widower)	1.03%
Profession	
Executive and intellectual profession	11.43%
Intermediate profession	16.10%
Employee	22.34%
Laborer	20%
Student	12.99%
Craftsman, trader and entrepreneur	7.01%
Retired	7.53%
Jobless	2.6%

One can easily note that impulse purchase involves all socio-professional categories. This means that these parameters are crucial for the segmentation of the market, i.e. to recognize the profile of impulsive buyers more easily.

5. Analyzes and results

5.1. Measuring impulse buying

The assessment of the impulse buying tendency is essential if one wants to identify unplanned purchases through a filter question that is asked when the respondent leaves the store:

Have you made a purchase that you have not planned to do today?

The main objective is to determine the products which were not planned to be purchased. In order to simplify the way in which the questionnaire was administered and to facilitate its acceptability, the respondents were asked to cite one or two purchases they had not planned to make. This question was asked to buyers who had already checked out. Only impulse purchasers can participate in the survey; then, the questions related to the different variables were asked. This is an open question for which there is no pre-established answer. It should be noted that the interviewee has complete freedom of choice in his response. This mode of question was chosen because it represents the major advantage sought in this study.

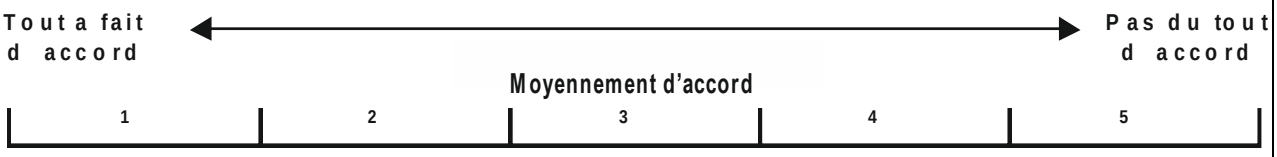
5.2. Physical environment

measuring the atmosphere at the point-of-sale

In order to measure the consumers' perceptions of the global environment at the point-of-sale, the five-point Likert scale, ranging from 1 (strongly agree) to 5 (strongly disagree), was used to measure attitude.

Measuring the variable : « *Evaluation of the point-of-sale's atmosphere* **»**

When you visited the store (point-of-sale), there was a pleasant atmosphere (Color, smell, Music, etc.)?



Scale for the measurement of affective states

As part of this research, the P.A.D. (Pleasure - Arousal - Dominance) scale, previously developed by Mehrabian and Russel (1974), was used to measure the affective states of consumers. Three dimensions are however considered, namely "Pleasure", "Arousal" and "Dominance".

Respondents were expected to rate each of the items using a five-point semantic differential scale.

How do you feel after your visit to the store (point-of-sale)?						
Dimension of pleasure						
	Strongly disagree	***Rather disagree***	***Neither agree nor disagree***	***Rather agree***	***Strongly agree***	
Unhappy	1	2	3	4	5	**Happy**
Sad	1	2	3	4	5	**Joyful**
Hopeless	1	2	3	4	5	**Full of hope**
Bored	1	2	3	4	5	**Enthusiastic**
Upset	1	2	3	4	5	**Calm**
Dissatisfied	1	2	3	4	5	**Satisfied**
Dimension of stimulation						
	Strongly disagree	***Rather disagree***	***Neither agree nor disagree***	***Rather agree***	***Strongly agree***	
Lively	1	2	3	4	5	**Apathetic**
Excited	1	2	3	4	5	**Unexcited**
Appeased	1	2	3	4	5	**Agitated**
Calm	1	2	3	4	5	**Aroused**
Relaxed	1	2	3	4	5	**Stimuled**
Overexcited	1	2	3	4	5	**Quiet**
Dimension of dominance						

	Strongly disagree	*Rather disagree*	*Neither agree nor disagree*	*Rather agree*	*Strongly agree*	
Dependent	1	2	3	4	5	**Independent**
Commanded	1	2	3	4	5	**Leader**
Weak	1	2	3	4	5	**Strong**
Guided	1	2	3	4	5	**Autonomous**
Influenced	1	2	3	4	5	**Influential**
Obedient	1	2	3	4	5	**Master of myself**

6. Preliminary results of the study

Characteristics of impulse buyers

During our survey, the questionnaire was administered to 590 visitors to the family clothing store. Of the 380 people who made impulse purchases, 56% were women and 44% were men.

Table 2: Percentage of purchasers who participated in the survey, by gender.

Gender	**Women**	**56.36%**
	Men	**43.64%**

These percentages indicate that women are more impulsive than men. This means that the uncontrollable frenzy of buying affects mainly women.

Table 3 : Measuring the atmosphere at the point-of-sale

Strongly agree	Somewhat agree	Strongly disagree
32.47%	**43.12%**	**24.41%**

It is important to mention that nearly 75% of those surveyed appreciate the atmosphere of the store they visited.

Table 4: The P.A.D (Pleasure – Arousal – Dominance) scale

Characteristics	Pleasure	Arousal	Dominance
	* Happy	* Appeased	* Master of myself
	* Satisfied	* Calm	* Autonomous
%	87	75	90

When reading the table, it appears that:

• 87% of those surveyed expressed a certain degree of agreement with the two items of the *Pleasure* measurement scale, namely "*Happy*" and "*Satisfied*".

• Regarding the *Arousal* scale, it is noted that more than 75% of the individuals express a degree of agreement with the items "*Appeased*" and "*Calm*".

• Concerning the scale for the measurement of "*Dominance*", more than 90% agree with the items "*Master of myself*" and "*Autonomous*".

Conclusion

The results of the present study confirm the fact that the atmosphere at the point-of-sale (music, smell, color, etc.) can be considered as an important element of management that can exert a significant influence on the behavioral, emotional and cognitive states of customers. Their sensitivity to the environment can lead them to feel impulses that they cannot or will not control. However, it turns out that the interior design of the store is capable of generating a positive experience for the consumer. Here, we place ourselves in a framework which indicates that the consumer goes through an affective experience when he is in a re-enchanted business environment. It is therefore essential for the store manager to offer distraction and pleasure to the consumer. It is also important for retailers to take care of the environment in their stores and to create an atmosphere that helps trigger purchasing impulses. It is therefore required to multiply stimuli inside the store (billboards, assistants, colors, smell, sounds, etc). Thus, the diffusion of music, smells in certain departments (hygiene, beauty, pastry, flowers, etc.), and warm colors (yellow or red) are all elements that can impel individuals to engage in impulsive purchasing. As a result, the layout of the store or point-of-sale is one of the main pillars of business success. It allows highlighting the quality of the products and services offered and encourages sales opportunities.

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PROCESS OF INTERORGANIZATIONAL KNOWLEDGE SHARING AND WOMEN'S ENTREPRENEURSHIP

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Abstract

The present study aims to identify how the process of interorganizational knowledge sharing contributes to women's entrepreneurship in the south of Santa Catarina State. A descriptive and exploratory methodological procedure with qualitative approach was carried, through a field research carried out with the associated women entrepreneurs of the State Council of Woman Entrepreneurs (CEME). The interorganizational knowledge sharing happens during meetings and events held by the CEME and in the Centers, as well as during interactions and informal dialogues among the participants, when tacit knowledge sharing occurs. Knowledge sharing causes organizational learning and contributes to the entrepreneurship of women participating on these events as following: (1) increase in knowledge; (2) creation of unity and connections; (3) information exchange; (4) motivation; (5) personal improvement; (6)

employee development; (7) promotion of necessary changes and (8) networking.

Keywords: Woman entrepreneur; Entrepreneurship; Interorganizational knowledge sharing; State Council of Woman Entrepreneurs (CEME).

1. Introduction

With the change in the world economic scenario in the last decades, and with the quickness of information transfer, knowledge became the main resource to companies that seek competitive differential and remain on the market. Thus, the search for means of management is necessary, which has been addressed by many authors of organizational theories (NONAKA; TAKEUCHI, 1997; DRUCKER, 1999; CHOO, 2000; TERRA, 2001).

However, the major emphasis of these studies is on the organizational knowledge management, in order to work with the intellectual capital existing in the company. These studies, when work only with internal knowledge, do not take the logic of society into consideration. In this sense, Castells (2006), when exposing about networks, states that every transformation on the economic scenario caused companies to form networks in order to achieve goals which were impossible to achieve alone.

Hence, this study intends to understand interorganizational knowledge sharing, which was addressed by Nonaka and Takeuchi (1997); however, it was not very well explored. Thus, with all challenges of endeavoring in nowadays economy, this study aims to identify how the process of interorganizational knowledge sharing contributes to women's entrepreneurship in the south of Santa Catarina State. The research has been applied by means of focal group interviews of women entrepreneurs in the southern region of Santa Catarina State, Brazil. Hence, the structure of this study follows the theoretical foundation with the themes entrepreneurship and knowledge management, followed by methodological procedures, results and research analysis and, concluding, their final considerations.

2. Theoretical Reference

2.1 Entrepreneurship

Entrepreneurship can be considered an active method to generate resources (RONSTADT, 1984), so that the entrepreneur is the person having the desire and competences capable of innovate, generating personal and economic development (SCHUMPETER, 1984), taking all opportunities and taking calculated risks. Being an entrepreneur is to develop a passion about the business and sparing no efforts to secure the survival of this business (BAGGIO; *BAGGIO, 2014).* Entrepreneurs are motivated and proud of what they do, have the perspective of being recognized by the society and admired for what they have built (DORNELAS, 2008). "An entrepreneur is somebody that dreams and seeks to transform this dream into reality" (DOLABELA, 2010, p. 25).

Dornelas (2005) states that entrepreneurship may happen from two perspectives: the entrepreneurship by opportunity, which comes from the visionary entrepreneur, and the entrepreneurship by need, which risks

all the possibilities of the entrepreneur due to lack of resources, as there is no employment alternative.
The entrepreneur shall use all her/his efforts forward favorable conditions provided by external environment, which in its turn stimulates and evokes society, generating innovation, Technology and economic growth (DOLABELA, 1999). In an overall vision, entrepreneurship can be founded how the actions taken by people to develop their businesses. This complex process involves not only the entrepreneur; it involves all the environment in which the entrepreneur and the business are inserted (Oliveira, 2012). Thus, endeavoring is acting in order to develop a new business or keep an existing one and, to do so, the entrepreneur needs specific abilities comprehending the need of doing knowledge management (LUCHESI, 2012).
Entrepreneurship in Brazil started to take shape after the creation of the Brazilian Service of Support to Micro and Small Companies (SEBRAE) and of the Brazilian Society for the Promotion of Excellence in Software (SOFTEX). These two entities spread the entrepreneurship in Brazil during the 1990s (DORNELAS, 2005).

2.2 Knowledge Management

Knowledge Management, besides dealing with management of intangible assets, also refers to the management of processes linked to these assets. That is, concerns the planning and decisions made towards the development of such assets and processes, with the objective of achieving an organization goal, improvement of products, services and decisions by means of flexibility and value adding (FIALHO et al., 2010).
Knowledge Management is connected to all learning processes in an organization, that is, it acts in the acquisition and development of knowledge, in the dissemination and in building memories, as well as in the process of elaboration of fundamental competences for the organization - (FLEURY; FLEURY, 2004). The application of knowledge management keeps the organizations constantly updated, promoting competitive advantage and creating innovation. Besides organizational knowledge, the knowledge of the entrepreneur itself adds value to individuals, which consequently will add value to the organization (SALGADO; CAMILOTTI; LEZANA, 2012). Entrepreneurship and knowledge management are strongly connected, because endeavoring is being constantly managing knowledge as a way of taking new actions, new ideas and new businesses, so that capabilities of individuals, developed by knowledge management, are necessary (SALGADO; CAMILOTTI; LEZANA, 2012).
Due to changes in the economic scenario, in order to keep companies competitive on the market, the adoption of new management models was necessary, where the proactive management of knowledge became the main axis of competitiveness of companies and countries (TERRA, 2001; TERRA, 2005). Knowledge, from this moment on, became main object of many studies. Almeida and Souza (2011) state that, in order to achieve the concept of knowledge, it is important to know the existing distinction between data and information. The authors understand data as the systematic register of all events, people or objects, as well as an address, a wage amount, birth date, among others. Such data, when processed, cumulatively, comparatively or in any other way, become likely to be interpreted and, later, constitute and information 2011. Davenport and Prusak (1998) state that information is the junction of data interpreted and that now

has a wider sense to the receptor. Knowledge, differently from data and information, is understood as the result of the relations happening in environments and that, my means of a learning process, develops itself and results in new practices (DAVENPORT; PRUSAK, 1998).

Knowledge divides into tacit and explicit. Tacit knowledge is internalized in the individuals and is difficult to be externalized and shared. Such kind of knowledge refers to beliefs, personal values and experiences, while explicit knowledge is easily accessible, as it is presented in formal language and can be found in documents, books, manuals, among other sources. According to the authors, knowledge creation in organizations is a result of the constant interaction between the two kinds of knowledge (NONAKA; TAKEUCHI, 1997).

This interaction among knowledges, also known as conversion, occurs in a spiral-shape, known as SECI, and happens in different levels: individual, group, organizational and interorganizational, starting by socialization, phase in which sharing of life experience and mental models occur. Subsequently, the stage of externalization happens, in which groups discuss and reflect upon what has been previously addressed; then, there is the stage of combination, the junction of the new and the old knowledge. To conclude, the stage the authors call "learning by doing", that is, the internalization, in which individuals put the new knowledge, resulting from the spiral-shaped process, in practice (NONAKA; TAKEUCHI, 1997).

2.3 Knowledge Sharing

To Fleury and Oliveira Junior (2001, p. 295), knowledge sharing "is defined as the process of knowledge dissemination inside a company or with other companies, under the control of the company owning this knowledge". Probst, Raub and Romhardt (2006, p. 136) define knowledge sharing and distribution as "a process of distribution centrally directed of knowledge between a given group of employees or it can be a knowledge transfer among individuals, or among teams or work groups" because knowledge is an element usually transferred during personal exchange among individuals.

Tarapanoff (2006) states that, when conceptualizing knowledge sharing, this is characterized as a process, not as an object *per se*. In order to have an easy, comfortable and transparent knowledge and information sharing implemented, the environment should be favorable to it, even before the implementation of usual knowledge management processes such as technologies, classifications, among others.

To Probst, Raub and Romhardt (2006, p. 161), "knowledge sharing and distribution have a prominent position in knowledge management", because such activities are the foundation for vital competitive factors such as time and quality, besides its leveraging, and for being a common thread to other aspects of knowledge management. The authors also emphasize that knowledge sharing and distribution in the organization is crucial, so that the information or experiences of individuals can be disseminated and used by everybody in the company. Thus, the premise is that there should have a knowledge coming from internal sources (knowledge development) or external (knowledge acquisition), followed by conditions for knowledge sharing and distribution that, according to the authors, is the set of the recognition and location (by the potential user) of the individual or organizational knowledge assets, by means of tools supporting the sharing and distribution of organizational knowledge, which comprehend physical, technical and organizational aspects of labor situations, both individual or group.

However, Probst, Raub and Romhardt (2006) state that the problems arise from knowledge distribution, because one of the greater difficulties regarding knowledge management is the distribution of knowledge to the right people, or make organizational knowledge available whenever necessary. Companies tend to underestimate this difficulty, as according to the authors, surveys show that more than half of the intellectual capital is not exploited and very few people possess the vital organizational knowledge, due to the difficulty of knowledge transfer to people who could use it.

Recent tendencies in the work format, such as the cooperation among companies in virtual organization, as well as the distance of individual forms of work, have led to the emphasis on workgroup, in which most of the employees work in groups or project groups, and the success of these groups directly depends on the efficiency of the knowledge sharing between their members; make knowledge sharing a crucial requirement for efficient organizations (Probst; Raub; Romhardt, 2006).

The same authors mention other organizational scenarios providing barriers to knowledge sharing, such as virtual offices and teams, sudden company structure changes, such as acquisitions or divestments, the spatial disposal of work areas, besides individual barriers that reduce the willingness or the capacity of people to disseminate knowledge voluntarily. For example, difficulty in describing, communicating or disseminating knowledge, possession of knowledge as only and particular property and knowledge as a power base in the company (PROBST; RAUB; ROMHARDT, 2006).

Davenport and Prusak (1998) also show some of the reasons why people in the organizations understand and absorb new knowledge, nevertheless, does not use this knowledge, such as lack of respect and or suspicion about the source of knowledge, resistance to changes, pride, stubbornness, lack of time, lack of opportunity and fear of taking risks; this latter, mostly, in companies that punish errors. Tarapanoff (2006) complement that a competitive, non-collaborative organizational culture is also a problem related to knowledge sharing, because departments, employees and executives compete among themselves, there is no motivation to knowledge sharing. In this sense, sharing or interchange of knowledge is subject to the culture of trust in the organization. Probst, Raub and Romhardt (2006) complement that despite the difficulty of establishing a trusted environment, this is crucial to knowledge sharing. Trust is built by short steps, through positive examples, however, negative events such as, for instance, the dismissal of an important knowledge agent, can cause evident effects on trust.

Probst, Raub and Romhardt (2006) state that such tendencies can be compensated by many of the existing aids for knowledge management, which have been advancing on methodology. Processes' structuration forms enhance new opportunities by means of more advanced technologies and more mature organizational methods. Davenport and Prusak (1998) corroborate and state that technology takes knowledge wherever necessary, however, it has the task of distributing and storing knowledge for interchange purposes; it is not capable of create neither guarantee or promote knowledge sharing. Such actions will only be possible if a corporate culture, stimulating these activities, exists.

Laudon and Laudon (1999) point out the benefits occurred to make organizational knowledge easily available. Simplifying the access to knowledge, improving the value of knowledge and use it to improve processes, are vital actions for a company to succeed and survive. The authors state that knowledge that cannot be communicated and shared with others become useless to the organization. Thus, the authors

forward ideas regarding the development of procedures and routines for knowledge creation, flow and sharing, and list training programs, informal networks, administrative experience shared and communicated through a culture of support as a mechanism for knowledge sharing. Complementarily, Rosa et al. (2011) show that knowledge can be shared by means of many mechanisms: tacit knowledge sharing demands mechanisms where interaction among people occur, while in order to explicit knowledge sharing happen, it is necessary to have tools in order to make the documentation of knowledge possible.

2.4 Interorganizational Knowledge Sharing

Knowledge sharing may occur inside the organization (intraorganizational), in which the main source of knowledge is the employee (DARROCH, 2003), or among organizations (interorganizational). In this case, knowledge can be acquired from competition, universities, suppliers, clients, among others (ROSA et al., 2011). Nodari et al. (2014) define interorganizational knowledge sharing is the process that allows mutual learning among companies, and happens by learning among members of different organizations, and when the conversion of individual learning into organizational learning happens.

Interorganizational knowledge transfer results on the development of organizational competences and, consequently, on organizational performance (NODARI, 2013), as well as it provides competitive advantage by means of the creation and management of knowledge sharing processes (DYER; NOBEOKA, 2000).

In a study about development of capabilities through interorganizational sharing, Nodari (2013) points out that there is a greater tendency of companies to participate in a knowledge sharing relation, in comparison to individuals. In other words, the more knowledge a company donates to a partner, the more the receiver will be able to donate its knowledge. That is, the more knowledge is collected, the more probable to donate it. Thus, it forms a vicious circle of knowledge sharing. The authors also state that the establishment of this process of donation and collection of knowledge is favorable to the development of dynamic capabilities; however, such relation is guided by the absorptive capacity of the company. Absorptive capacity is the ability of a company to recognize the value of new and external information, assimilate and apply them to commercial purposes, what is crucial for innovative capacities (COHEN; LEVINTHAL, 1990). All this is added to the fact that, in order to develop organizational competences and, consequently, impact positively on organizational performance, the company shall not only provide knowledge, but also collect it (NODARI, 2013).

Chen et al. (2006) forward ideas on the crucial importance of external knowledge to small and medium-sized companies, and complete that they are in need of external knowledge and interorganizational knowledge transfer. Through their survey regarding interorganizational knowledge, which promoted a vision about practices and needs to practice knowledge transfer in small and medium-sized companies in the United Kingdom, Chen et al. (2006) point out that the engagement in activities of interorganizational knowledge transfer, social and electronic networks are important channels for companies to acquire knowledge needed. The survey shows that it is more likely to acquire important knowledge from social networks than by electronic social networks. In their study, the authors related that 99% of the companies studied shown the need for interorganizational knowledge transfer, and are intensely involved in activities

such as meetings with clients, counseling with friends or members of other organizations. Some of them share knowledge even with their competition. Such activities show themselves as important paths to interorganizational knowledge transfer (CHEN et al., 2006).

3. Methodology

The present study has as main goal to identify how the process of interorganizational knowledge sharing contributes to women's entrepreneurship in the south of Santa Catarina State. For this purpose, this study is characterized as interdisciplinary, with use of applied and exploratory research, through qualitative approach, made by a field study held with women entrepreneur and associated to the State Council of Woman Entrepreneurs (CEME).

The field study was held by means of interviews, using a semi structured script formed by topics, in discussion groups, with two groups of 5-7 women belonging to the Southern region of Santa Catarina State, Brasil. The women interviewed work in varied sections of retail, industry and services. The script was made with the objective of identifying how the interorganizational knowledge sharing happens among the women associated to the CEME during the meetings and workshops developed by them, and how this sharing contributes to the growth of their companies or for the companies in which they work.

CEME, founded in 1997, is the female extension of the Federation of Business Associations of Santa Catarina State (FACISC), considered the biggest representative body of female entrepreneurship class, intensely acting in all regions of the state. Formed by the Women Entrepreneur Centers all over Santa Catarina State, the CEME gathers until the present date, 53 centers, responsible for the movement of around a thousand companies (CEME, 2017).

4. Results

The present section addressed the data description and result discussion, as per data collected by the researchers. As shown by Table 1, the identification of some forms related by both groups was identified, in which interorganizational knowledge sharing promoted by the CEME meetings and by Centers contribute to women entrepreneurs participating on these events.

Table 1. Improvements brought to entrepreneurship.

Improvements brought to women's entrepreneurship by means of interorganizational knowledge sharing held by the CEME	
Increase in knowledge	Motivation to act in companies
Creation of unity and connections	Employee development
Personal improvement	Promotion of necessary changes
Information exchange	Networking

Source: Research data (2017).

Through the stories of the interviewees, both groups listed improvements that knowledge sharing provided by the CEME and by the Centers has brought not only to their enterprises, but also to women in the role of entrepreneurs.

A factor highlighted was that knowledge sharing which happens even between entrepreneurs that compete on the market. The women interviewed welcomed this sharing and agree that, in this case, competition does not interfere and all sectors are benefited by it, because brings growth. This knowledge is presented in several ways, such as technical visits, lectures, *workshops*, meetings and events held for the members and, mostly, it is shown in informal interactions among the entrepreneurs, what they call exchange of information. During these meetings, there are moments in which the members dialogue informally among each other. These are great opportunities for tacit knowledge sharing. Rosa et al. (2011) supports this practice and shows that tacit knowledge sharing demands mechanisms in which the interaction among people happens. According to the women interviewed, these opportunities provided by the meetings add a lot to their businesses, towards motivation, overcoming barriers, generation of new ideas and in problem solving, as stated by the interviewees E4 of Group 1: "The exchange of ideas adds value to every kind of business" (E4, Group 1). The interviewee E1 of Group 2 complements and states:

> I am here since 2010 and I have learned a lot of things, indeed, besides the exchange among colleagues. Sometimes we think we have a huge problem, and talk to other person that also have it, and you minimize your problem after this talk. It is like a therapy, you know, so I guess this information exchange is very important to women entrepreneurs' lives and to create partnerships (E1, Group 2).

These reports meet the thoughts of Chen et al. (2006), when state that the involvement in activities of interorganizational knowledge transfer, social and electronic networks are important channels to companies to acquire the knowledge needed: it is more likely to acquire important knowledge from social networks than through electronic networks.

The women interviewed state that such knowledge make the entrepreneurs see the necessity of change in their endeavors, which becomes an improvement provided by sharing. When having it, they have the opportunity to see the mistakes made towards their endeavors and, from these mistakes, promote the changes needed to fix them, as stated by the interviewee E3 of Group 2: "I guess that is it, we will see the things we are doing right and other simple things that we did not realize and understand that everybody make mistakes, so, we vary, improve what we learn and fix things we were not doing right".

The women interviewed also state that the participation in meetings is an opportunity that depart them from the daily duties imposed by the direction of their businesses, dedicating some time to think, reflect and make plans to their endeavors, what is usually not possible due to the overload imposed by work and personal life tasks as mothers and wives, as stated by the interviewee E7 of Group 1: "I should take a time to do this, to start organizing my things, to organize my tasks because everything is like 'everybody does everything', you know, so I should do it too" (E7, Group 1).

Personal improvement was also mentioned in the narratives. The women interviewed state that having

access to this experience of knowledge sharing, and the interaction with other entrepreneurs of different places of Santa Catarina State, benefits not only the company, but the women as well. The women state that this interaction is a motivating factor. Participating in meetings and events, interacting with other women that are often facing the same problems, make them feel more secure in relation to their businesses, as stated by the interviewee E4 of Group 2: "We need to go after this motivation, this space to get motivated, so you can administrate your business". The interviewee E5 of Group 1 complements, stating that motivation is one of the greater gains provided by sharing in meetings, which brings us more willing to work and continue their business: "I guess motivation is what we most bring, right? We leave the place more motivated, you know? Tomorrow we will get up feeling better, we will go to work feeling different" (E5, Group 1).

The development of employees was also an improvement brought by the knowledge sharing held by meetings. The women interviewed acknowledge the importance of sharing the knowledge acquired in meetings with the employees of their companies, and such behavior is crucial to the development of the company. To Nodari et al. (2014) this cycle causes the organizational learning, that is, after mutual learning among companies, the individual learning conversion arises in organizational learning. The interviewee E2 of Group 1 shows how this sharing happens: "We gathered together [the city of] São José, then I arrived and I showed [something] to them, [and said] look how nice it is, what we can take advantage from, so we share [this knowledge], all together".

The narratives also shown that the participation in meetings and knowledge sharing creates unity and connection between the participants, an important factor in the view of entrepreneurs, because this way they feel supported in difficult times, as related by the E1 of Group 1:

> "So, whether you want it or not, we create a unity, we continue to create, I guess, you create bonds with people when you participate on things, and make friends, so, I guess it is very important, so this is a matter of unity, because you cannot walk alone".

To conclude, the authors understand that these meetings strongly foster the networking among participants, which is extremely important to their professional life nowadays. The women entrepreneur state that, through the meetings, they had the opportunity of selling their products with other entrepreneurs, increased their client portfolio by indicating their services among the members of the centers, had the opportunity of disclosing their business and setting many partnerships with the participants. As stated by the interviewee E4 of Group 2: "[we] benefit from networking, besides the constant interaction with other people, with other entrepreneurs" (E4, Grupo2).

The authors perceived that all the cycle of knowledge sharing provided by the meetings of CEME and Centers, corroborates what Nodari (2013) states about interorganizational sharing, that is, sharing the knowledge of the organization with members of other organizations results on a greater shared knowledge flow, taking into account that, when getting knowledge, the receptor will be more willing to donate knowledge to the partner company, which results in competitive advantage and better organizational

performance.

5. Conclusion

The goal proposed to the present study aimed to identify how the process of interorganizational knowledge sharing contributes to women's entrepreneurship in the south of Santa Catarina State. The participation in meetings and in events promoted by the CEME and by the Centers provide to women entrepreneurs a high flow of interorganizational knowledge sharing, which, according to the literature, cause the organizational learning, essential for the increase and development of organizations.

The authors understand that information sharing does not happen only through technical visits, lectures, workshops, meetings and events, as well as during informal meetings, dialogues and interactions, including meetings with other entrepreneurs competing in the market. During these meetings, tacit knowledge sharing happens, which is considered by the women entrepreneurs as excellent opportunities of learning, not only for their endeavors but for women in their role of entrepreneurs. Such moments motivate them regarding the overcome of obstacles, generation of new ideas and problem solving. This knowledge also makes the women interviewed to see what points of their businesses need changes and improvements because, when getting new knowledge, these women have the opportunity of observing and finding their mistakes and apply corrective measures.

These meetings also shown a way of escaping their turbulent agenda and dedicate exclusive time to reflect and plan their endeavors. They acknowledge the importance of having knowledge sharing not only among the women entrepreneurs, but also inside the company.

To conclude, the authors understand that these meetings strongly promote networking among the participants, which results in the opportunity of selling their products with other entrepreneurs, increased their client portfolio by indicating their services among the members of the centers, had the opportunity of disclosing their business and setting many partnerships with the participants.

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Using Data Mining for Improving Education of University Students – A Survey

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Abstract

Data mining combines machine learning, statistical and visualization techniques to discover and extract knowledge. Student retention is an indicator of academic performance and enrolment management of the university. Poor student retention could reflect badly on the university. Universities are facing the immense and quick growth of the volume of educational data stored in different types of databases and system logs. Moreover, the academic success of students is another major issue for the management in all professional institutes. So the early prediction to improve the student performance through counseling and extra coaching will help the management to take timely action for decrease the percentage of poor performance by the students. Data mining can be used to find relationships and patterns that exist but are hidden among the vast amount of educational data. This survey conducts a literature survey to identify data mining technologies to monitor student, analyze student academic behavior and provide a basis for efficient intervention strategies. The results can be used to develop a decision support system and help the authorities to timely actions on weak students.

Introduction

Simply, data mining is considered as a process that takes data as input and outputs knowledge which initially was known as the Knowledge Discovery in Databases (KDD) process. Many other terms are being used to interpret data mining, such as knowledge mining from databases, knowledge extraction, data analysis, and data archaeology. It is also defined as a nontrivial process of identifying valid, novel, potentially useful, and ultimately logical patterns in data (U. Fayyad, G. Piatetsky-Shapiro, and P. Smyth, 1996). This has been aided by some other techniques in the field of computer science, such as neural networks, classification, clustering, genetic algorithms, association rules and support vector machines. Data mining is the process of applying these methods to data with the intention of uncovering hidden patterns.
Data mining is an emerging powerful tool for analysis and prediction. It is successfully applied in different areas such as fraud detection, advertising, marketing, loan assessment and prediction. But, it is in emerging stage in the field of education. This research would focus on a comprehensive survey, a travelogue (2000-2018) towards educational data mining and its scope in future.
One of the primary goals of the educational system any higher education institute must focus on preparing students with the knowledge and skills needed to convert into successful careers within a specified period (especially within three or four years). How effectively these educational systems meet this goal is a major determinant of both economic and social progress of any country.

There are currently fifteen universities in Sri Lanka, which are established under the authority of the University Grants Commission (Universities, 2018). All these universities accept approximately 30,000 students in each year. It has become difficult to provide high quality teaching and guidance to such a large number of students. As a result, many students fail to complete their degrees within the required periods. Using data mining (DM) techniques to analyze student information can help identify possible reasons for student failures.

Within recent few years, the number of educational institutes that adopted an information system has been growing very quickly; consecutively the amount of data available in each educational institute database has also increased. Educational data mining is intuitively applied to discover hidden information from this data that would improve the quality of the whole educational system. Educational data mining can be applied to discover patterns in untrusted datasets to automate the decision making process of learners, students and administrators.

This knowledge extracted from students' data can be used in different ways such as to validate and evaluate an educational system, improve the quality of T& L processes, and lay the groundwork for a more effective learning process (C. Romero, S. Ventura, and P. De Bra, 2004). Similar ideas have been applied successfully, especially in business data, in different datasets, such as e-commerce systems, to increase sales profits.

If universities could identify the factors which affect the low performance as earlier as possible and hence are able to predict students' behavior in different perspectives, the administration can use this knowledge in taking actions in order to overcome issues related and to improve the performance of such students. It will be a win-win situation for all the stakeholders of universities/institutions i.e. management, teachers, students and parents. Students will be able to identify their weaknesses beforehand and can improve themselves. Teachers will be able to plan their lectures as per the need of students and can provide better guidance to such students. Parents will be reassured of their ward performance in such institutes. Management can bring in better policies and strategies to enhance the performance of these students with additional facilities. Eventually, this will help in producing skillful workforce and hence sustainable growth for the country.

Literature Survey

Castro (2007) categorized data mining tasks used in higher educational institutes into four different areas: applications that deal with the assessment of students learning performance, course adaptation and learning recommendations to customize students learning based on individual students behaviors, developing a method to evaluate materials in online courses, approaches that use feedback from students and teachers in e-learning courses, and detection models for uncovering student learning behaviors. Later, Baker and Yacef (2009) suggested four key areas of educational data mining application, namely, improving student models, improving domain models, studying the pedagogical support provided by learning software, and conducting scientific research on learning and learners using five approaches/methods: prediction, clustering, relationship mining, distillation of data for human judgment, and discovery with models.

Work related to data mining process can be divided into two main categories: data mining and visualization. The category of statistics and visualization has received a prominent place in theoretical discussions and research (C. Romero, S. Ventura, M. Pechenizkiy, and R. S. Baker, 2010) (R. S. Baker and K. Yacef, 2009). Baker (R. S. Baker and K. Yacef, 2009) classifies the work as follows:

1. Prediction.
    - Classification.
    - Regression.
    - Density estimation.
2. Clustering.
3. Relationship mining.
    - Association rule mining.
    - Correlation mining.
    - Sequential pattern mining.
    - Causal DM.
4. Distillation of data for human judgment.
5. Discovery with models.

Discovery with models category identifies which learning material subcategories provide students with the most benefits (J. Mostow and J. Beck, 2008), how specific students' behavior affects students learning in different ways (M. Cocea, A. Hershkovitz, and R. S. Baker, 2009), and how tutorial design affects students learning (H. Jeong and G. Biswas, 2008).

Outlier detection is another educational data mining methodology which has not been used widely. It discovers data points that significantly differ from the rest of the data (V. J. Hodge and J. Austin, 2014). In educational data mining, they can detect students with learning problems and irregular learning practices by using the learners' response time data (Chan, 2007) and deviations in teaching learning activities (Muehlenbrock, 2005).

Text mining which works with datasets such as text documents, HTML files, emails, etc., has been used in this area to analyze data in Learning Management Systems (Ueno, 2004), (L. P. Dringus and T. Ellis, 2005) and in web content mining (J. Chen, Q. Li, L. Wang, and W. Jia, 2004). Use of text mining for the clustering of documents based on similarity and topic has been proposed (J. Tane, C. Schmitz, and G. Stumme, 2004), (C. Tang, R. W. Lau, Q. Li, H. Yin, T. Li, and D. Kilis, 2000).

Prediction methodology studies features used for prediction and uses those features in the underlying construct to predict student educational outcomes (C. Romero, S. Ventura, P. G. Espejo, and C. Herv´as, 2008).

Association rule mining is the most common educational data mining method. The relationship found in association rule mining is {if –> then} rules. For example, if {Student GPA is less than two, and the student has a job} → {the student is going to drop out of school}. The main goal of relationship mining is to determine whether or not one event causes another event by studying the coverage of the two events in the data set (C. Wallace, K. B. Korb, and H. Dai, 1996), or by studying how an event is triggered.

Data used in Mining Educational Data

Different data mining techniques are used to analyze educational data and solve issues related to education. Similar to other data mining techniques, it is needed to extract interesting, interpretable, useful, and novel information from educational data. However, this is specifically concerned with developing methods to explore the unique types of data in educational settings (S. K. Mohamad and Z. Tasir, 2013). Offline education, also known as traditional education, is where knowledge transfers to learners based on face-to-face contact.

Data which can be collected by traditional methods such as observation and questionnaires is one of the source of data used in educational data mining. It studies the cognitive skills of students and determines how they learn. Therefore, the statistical technique and psychometrics can be applied to the data.

Another way to collect data is from materials, instruction, communication, and reporting tools that allow them to learn by themselves used in e-learning and learning management systems (LMS). Data mining techniques can be applied to the data stored by the systems in the databases.

Intelligent tutoring systems (ITS) and adaptive educational hypermedia systems (AEHS) try to customize the data provided to students based on student profiles. As a result, applying data mining techniques is important for building user profiles.

Based on the above sources, we can group EDM research according to the type of data used: traditional education, web-based education (e-learning), learning management systems, intelligent tutoring systems, adaptive educational systems, tests questionnaires, texts contents, and others.

Summary

Prediction develops a model to predict some variables base on other variables. The predictor variables can be constant or extract from the data set. This identifies at-risk students and understand student educational outcomes.

Clustering groups specific amount of data to different clusters based on the characteristics of the data. The number of clusters can be different based on the model and the objectives of the clustering process. This finds similarities and differences between students or schools and categorizes new student behavior.

Relationship Mining extracts the relationship between two or more variables in the data set. This finds the relationship between parent education level and students drooping out from school. Discovery of curricular associations in course sequences and discovering which pedagogical strategies lead to more effective/robust learning.

Moreover, some models aim to develop a model of a phenomenon using clustering, prediction, or knowledge engineering, as a component in more comprehensive model of prediction or relationship mining. Discovery of relationships between student behaviors, and student characteristics or contextual variables; Analysis of research question across wide variety of contexts

With the ability to uncover hidden patterns in large databases, universities can build models that predict with a high degree of accuracy, the behavior of population clusters. By acting on these predictive models,

educational institutions can effectively address issues ranging from transfers and retention, to marketing and alumni relations.

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Situational Language Teaching Approach to Oral the English Teaching in Primary Schools

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Abstract

This paper aims at analyzing some applications of Situational Language teaching to the oral English learning in primary schools. Through this study, teachers could get some advice and improve their oral English teaching efficiency.

Key words: Situational Language Teaching, oral English teaching, primary school students

I Introduction

1.1Oral Englsih teaching

Oral English competence is an essential part of English teaching and is also one of the important goals of English learning. In traditional English teaching, the teaching of reading and translation has been emphasized, while the cultivation of communicative competence has been neglected. The students who are cultivated by the traditional English teaching methods with strong reading ability and writing ability, while their listening and speaking ability are not very good. “Dumb English” is used to refer to these students. Therefore, oral English teaching has been placed in a more prominent position. It has been a relative difficult thing for most Chinese people to learn English well. Apart from the difference in language family, we are also affected by the language environment, teacher education, college entrance examination, the preparation of teaching materials and other factors. Then, the actual development of students cannot keep up with the needs of the current situation.

1.2 Situational language teaching

The emergence of situational language teaching method has a great relationship with sociology, psychology and linguistics. Since mid-nineteenth century, sociology, psychology, and linguistics have been greatly developed, especially the rise and development of structuralism and behaviorism, which plays a significant role in the emergence of situational teaching method. And situational teaching method is mainly inspired by structural linguistics and behavioral psychology.

On the one hand, the situational teaching method is influenced by the structural linguistics. Structural linguistics was proposed by the Swiss linguist Ferdinand de Saussure. He thought that language is a system

of signs for expressing ideas and these linguistic signs have two major characteristics. First, linguistic signs are arbitrary. Second, signs are with lines. The arbitrary nature of language signs is the value of the unit in the system and the value and the unit depends on the position and relationship of the system in the whole structure. While, line means that signs can only be launched in time, one after another, and constitute the chain. In any given situation, the essence of a factor is not significant in terms of itself. In fact, its meaning is determined by the relationship between it and other factors in the given context. To understand the whole, it is necessary to cut off the elements from the whole, and these elements are connected with each other. To be short, structural linguistics mainly consists of two aspects. One is to analysis language elements. Another is to analyze the arrangement of these elements. Situational teaching method is influenced by the structural linguistics, which takes the language as a structure. It is a regular system. Therefore, in the course of language teaching, we should pay more attention to the syntactic structure. Meanwhile, according to the sentences, we choose the right words. Moreover, the choice of the words must serve the needs of the sentence patterns.

On the other hand, situational teaching method is not only affected by the structural linguistics, but also is influenced by behaviorism. Based on Pavlov's classical conditioned reflex theory, American psychologist Watson found the behaviorism. He believes that human behavior is acquired after birth and environment plays a decisive role in a person's behavior. What's more, behavior can be modified, added or eliminated by learning. Skinner developed the theory of reinforcement which is also called the ope rant conditioning theory or the correction theory on the basis of behaviorism. This theory is also the core of the new behavioral learning theory. And Skinner thought that the behavior can be divided into responsive behavior and ope-rant behavior. The latter is more significant than the former in the learning process and all the behavior of people is almost the effect of operational reinforcement. We can change the reaction of people through intensive operation. According to behaviorism, that people learn a king of language is stimulated first, and then they react and strengthen .Under the influence of his thought, the acquisition of language is a kind of behavior reinforcement learning and when in practice, people need to repeat, imitate and transform the information of language habits. Moreover, external environment plays a significant role in the process.

Under the impact of the thought of structuralism linguistics and behavioral learning theory, situational teaching method emerged and thrived in England in 1930s, and it was introduced into China in the late 1970s. Generally speaking, situational teaching method is a kind of pattern in which teachers create some real or stimulation scenarios and cases through all kinds of aids and information technology to reappear the content of teaching. Ultimately, students can link the knowledge and life together.

1.2 The goal of the paper

With the rapid development of society and economy, we are entering to an era full of intercultural communication and globalization. There is no doubt that we do require a new demand of English. That is to say, our society is in urgent need of the talents who are proficient in business and can convey their thoughts and feelings in fluent English. Furthermore, no matter the outline requirements and social needs, it is definitely a vital and severe task to strengthen the oral English teaching through some efficient ways

as English is the most widely used language.

In the "Basic Requirements of Primary School English Teaching", the Chinese Ministry of Education said that the teaching of English should pay close attention to cultivate students' communicative competence and interests in English. Therefore, it has become a common task for teachers to improve the ability of pupils' oral English. Obviously, about the English teaching in primary schools, our teachers should focus on all kinds of ways to teach oral English. Situational language teaching approach conform the mental characteristics and cognitive law of primary school students. It is a new theoretical and practical method which is aimed to improve the efficiency of teaching. Different from the traditional teaching method, it is more suitable for the regularity of language education. In addition to, it has a great effect on promoting integrated development of students and improving the efficiency of teaching. Situational language teaching method not only energizes the atmosphere, but also makes students be in a learning environment full of imagination.

While, under situational language teaching method, students can exert their initiative and creativeness in a better way. On account of fewer theses in this aspect, it is valuable to explore how to take advantage of situational teaching method in oral English teaching to primary school students.

Ⅱ Theoretical Base

2.1 Psychological characteristics of primary school students

Situational language teaching method is suitable for the psychological characteristics of primary school students. Because primary students are young, animated, and imaginative and they are good at imitating. What's more, for them, it is so easy to remember some visual and vivid images. However, the time of their attention is relatively short. The traditional teaching method of explaining through translation enables students feel tired and fainthearted. Therefore, we should notice this psychological characteristic of primary school students and manipulated situational language teaching method during the teaching of English.

2.2 The situation of Chinese students learning English

Situational language teaching method is propitious to the situation of Chinese students learning English. The ultimate goal of learning language is to use it in real communication context, so it is so necessary to enable students surrounded by the target language. Nevertheless, our Chinese students lack the atmosphere of learning English. Under this circumstance, English teachers should create as many as possible communicative scenes for students in the class.

Furthermore, the desire to show off of primary school students is strong. If students can speak English fluently and appropriately in the simulated scene during the class, they will naturally utilize what they have acquired in class in the real communicative context. Consequently, by this way, the efficiency of leaning English is improved.

2.3 Cognitive law of primary school students

Situational language teaching method is fit for the cognitive law of primary school students. The representative of social interaction studies—Bruner stressed that interaction plays a decisive role in the

process of acquiring a language. Meanwhile, he pointed out that the practice of language communication is a decisive factor in children's acquisition of language. The new behaviorist Skinner pointed out that memorizing mechanically has less benefit to students. Only in the concert context can they acquire a language well.

Ⅲ The specific application of SLT(Situational Language Teaching)

3.1 Multimedia technology

To begin with, teachers can take advantage of multimedia technology to create circumstance. Nowadays, most of the students have more access to the internet as they are curious about the online world. If English teachers manipulate multimedia technology during the process of teaching, they can enable the abstract things be more intuitive and make the boring teaching material be more vivid. Then, through this method, students will develop a strong interest and this way also makes a deep impression on them. For example, we can by means of multimedia courseware and animation clips to stimulate primary school students' attention. Then, the listening and speaking of students will be improved relatively. Furthermore, the stimulation of visual images can improve students' initiative and creativeness.

In addition to, in order to enrich the content of the class, teachers can add some pictures, animation, as well as some other factors. In this way, these approaches can arouse students' curiosity and interest. Naturally, according to the guidance of teachers, students will learn consciously and achieve the goal of high efficiency. But, we must pay attention to the added content which must be appropriate. Meanwhile, the added content cannot be out of the teaching objectives which enables students learn some helpful knowledge.

3.2 Visual teaching aids

From the aspect of psychology of primary school students, it is an easier issue for them to accept visual things as this kind of method can mobilize their enthusiasm. Pictures, models and some other visual things are good inducement for primary school students. If teachers can cooperate with students through taking advantage of those visual teaching aids during the process of teaching English, the efficiency of teaching will be striking and remarkable.

For example, in the process of teaching English words—"run" and "dance", teachers can make use of some pictures to motivate students' imagination. Then they may think about the meaning of the words. Teachers ask students, "can you dance?" and students will answer "Yes, I can. I can dance." After all, using pictures to teaching English, teachers can create active atmosphere of the class. Ultimately, students will be more interested in English and learn English consciously. It is said that interest is the best teacher.

3.3 Role-play

It is no doubt that role play is a way to render the atmosphere of the class. As primary school students are born to love performance and imitation. So teachers can take advantage of this feature to create the atmosphere of role play. Consequently, students can deepen the impression of the specific knowledge through their preparation of the performance. Besides, role play is also a good way to motivate their desire

and enthusiasm of learning English.

For example, when we learn the sentence pattern-"would you like to do sth", we can assume some scenes, such as classrooms, cinemas, supermarket and emporiums. Then teachers ask students to make a decision of the scene they want to perform. Meanwhile, they must use the specific sentence patterns to communicate with their patterns during their practice. Student A can ask student B, then students B should answer the question according to his or her actual situation. Therefore, students can experience the joy of learning English in the immersive atmosphere of the class. In addition to, students can obtain a good opportunity of performing in front of the classmates to achieve their integrated development.

3.4 Games

We cannot deny that it is definitely benefit for primary school students to use all kinds of games to attract primary school students' attention. Based on the age characteristics of primary school students, games can stimulate their interest of learning. Furthermore, only in the relaxed atmosphere can students receive knowledge naturally and unconsciously.

For example, English teachers plan to teach some words of animals in the textbooks. For example, tigers, cats, birds and monkeys. Obviously, English teachers can add some games to increase their interest of English. That the teacher must pay attention to is that words cards should be prepared before the class. Teachers also need divide the whole class into several groups to compete with others. First of all, each group of students must choose a representative to delegate for them in each round. In the specified time, the group who answers the most words is the final winner group. What's more, the winner one can gain some gifts from teachers to encourage them. It can not only enable students learn English harder, but also increase the sense of group honor.

Ⅳ Conclusion

4.1 Issues that need to be noticed

In the exploration of utilizing situational teaching method, English teachers need to think constantly and overcome the deficiencies. Meanwhile, teachers are also required to improve the teaching mode and accumulate experience of teaching. What's more, it's a final target for teachers to fully tap the great potential of situational teaching method. Ultimately, the effect of oral English will implement a new height. However, considering the current teaching, there are some aspects which we should focus on in the English class of primary school students.

Firstly, teachers should avoid the situation that the form is far away from the teaching content. At present, it has become a universal problem for the English class in primary schools. Furthermore, it is more likely to come to extremes. On the one hand, the teaching content covers too wide knowledge. More scenes will cause more questions. Furthermore, students will relatively lack emotional experience if the rhythm is too nervous. It is difficult for students to discover problems only in ephemeral time. Certainly, they are also no time for them to think carefully. On the other hand, the form is so cumbersome so that students just pay attention to the process of experiencing. They don't comprehend deeply the knowledge behind the scene. Then, the purpose of the situational teaching method deviates from textbooks. Although the diversity of the

teaching patterns enables knowledge understandable for and acceptable for students, the excessive and overmuch presentation can lead the result that students become blundering and thoughtless.

Secondly, teachers should avoid the situation that it is not balanced between creation and presentation of the class. The disorder of creating and presenting mainly refers to the excessive design of teaching. When teachers make use of situational teaching method, the creation of the class is one of the significant links for the whole class. However, in the actual teaching, cumbersome creation will reduce the effect of teaching. Therefore, teachers should focus on clear teaching objectives and teaching ideas before the class. What's more, Teachers should have a macro presupposition of the class.

Thirdly, teachers should avoid the disorder between preparation and reflection of the class. In the teaching of situational language teaching method, the preparation of the class is necessary, which can help students adapt to the scene. What's more, the reflection after the class is very significant, while, the traditional teaching only pay attention to the effect of the class and ignore to summary the whole class. And teaching reflection is the summary of teachers and students.

Fourthly, teachers should avoid the fuzzy relationship between objectives and dominants. Situational language teaching method covers a process of mutual exchange between students and teachers. Hence, the interaction between teachers ad students become particularly important. Nowadays, the teacher-centered class is out of date and useless while the pattern of students centered is priority to the former one. Although it is difficult to achieve this goal, teachers should try their best to finish this task. What's more, the interaction between students is also very significant as peers are more likely to discover problem of each other. That students receive knowledge initiatively will gain a better result.

4.2 Recommendation for further research

All in all, in order to manipulate situational teaching method, various and numerous things must be paid attention to. To begin with, the preparation of teachers before the class must be ample and abundant. That is to say, everything must be ready for transformation of the class. Otherwise, the teaching of the class will become vague and general. This thesis mainly talks about the application of situational language teaching approach in oral English teaching to primary school students. However, there are also other factors which need to be noticed.

For example, which qualities of teachers need to possess when they utilize situational language teaching method? Possibly, teachers are required to be good guides who teach students right pronunciation of English words. Perhaps, they are required to provide the motivation for learning English continually as students will improve themselves quickly during the practice of speaking English. Therefore, how to deeply take advantage of situational language teaching method is considered to make more research on.

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Resilience Strategies for Successful Aging

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Abstract

The objective of this research was to analyze the strategies resilience and SOC (selection, optimization and compensation) in elderly residents of Ivoti/Brazil. The methodology used was quantitative and descriptive. Participated in the study 193 people aged 60-79 years living in the city of Ivoti. The instruments used were the Resilience Scale and the Inventory SOC. It was found that the participants scored on scale high resilience and the SOC strategy used mostly was the selection for loss, followed by compensation. There was no significant difference in the use of strategies by men or women, or in relation to age groups 60-69 years and 70-79 years. The conclusion was that to be resilient may be a necessary factor for successful aging materializes.

Keywords: Resilience; SOC; Successful aging.

1. Introduction

When people think about the aging process, it is very common that the expected losses that come with age, along with the difficulties associated with them, that are referred in the first place. However, considering

that the aging process is irreversible, it must always be taken into account that the most important is how the elderly manages to deal with the losses related to old age, in order to maintain their functional capacity and quality of life in appropriate levels. This aspect is strongly related to the way in which the elderly person perceives their life and with the subjective characteristics related to an aging with quality of life [1].

An attempt to understand aging in an integrative way in physical, psychological, and social aspects culminated in Paul B. Baltes and Margret M. Baltes [2] lifelong development theory, known as lifespan, which advocates the possibility of a successful aging process. The lifespan paradigm deals with the study of individual development from birth to old age. The main premise of this approach is that development is not completed in adulthood but extends throughout the course of life. Since conception, adaptive processes of acquisition, maintenance, transformation, and wear are involved in the psychological and functional structures. Thus, it considers the ontogenesis of behavior and the mind dynamic, multidimensional, multifunctional and non-linear. This paradigm of development is of a pluralist nature, since it considers multiple levels, temporalities and dimensions of development. It can also be considered transactional, dynamic and contextualist as a continuous, multidimensional and multifactorial process of modifications, influenced by genetic-biological and sociocultural issues, of a normative and non-normative nature, demarcated by gains and losses and by the interaction between the individual and the culture [3]. Therefore, Baltes [1] developed the SOC - Selection, Optimization and Compensation intervention model as a way of describing development in general.

The SOC model seeks to situate how individuals can handle changes in the biological, psychological and social conditions that are constituted over the course of aging. Selection means specification and reduction of the alternatives allowed by individual plasticity. Regarding selection, there are two types: loss-based and elective. The first refers to the reorganization of the person's life based on some loss. In this type of selection there is a restructuring of the hierarchy of objectives, a search for new goals or adaptation of new standards that can be reached according to the person or the surrounding environment. Elective selection is characterized by the choice of a particular goal and the disregard of another not so important [4,5,6]. Optimization is consistent with the acquisition, expansion and maintenance of internal and external resources involved in achieving an operation more suited to the individual context. The focus of optimization is on acquiring, enhancing, and maintaining resources or resources that are effective in achieving desirable outcomes and avoiding those that are undesirable. It requires a systemic coalition between health factors, environment and psychological conditions, as well as investing in goals and pursuing goals. The compensation relates to the functional response that the individual manifests to a loss, seeking to maintain the functioning. Compensation is divided into two categories, the former being characterized as the change of objectives to be achieved, often shifting to a less ambitious objective, once the constraints begin to develop. The second is characterized by maintaining the same goal, but with the addition of differentiated strategies to achieve them. In summary, the compensation will involve the adoption of alternatives aimed at maintaining the operation [7].

Within the SOC model, the decline due to biological age can be compensated until the individual reaches a very advanced age. This compensation is determined by the allocation of internal resources and the contribution of culture, which act interactively. This process occurs properly until these factors enter

into imbalance, which would occur from the 80 years, at the present time [1].

Analyzing the strategies used to promote a healthy aging, it is necessary to promote protective factors since they are strong influencers of the ability to adapt to risk factors. This adaptation ability is called resilience. Considering resilience as a process, it is not possible that is an attribute of the person or a characteristic acquired throughout development [8]. It should be considered as an interactive phenomenon between the individual and his environment. Resilience is the human ability to cope, overlap and be strengthened or transformed by experiences of adversity.

Therefore, it is important that, with the aging process, the resilience capacity of the elderly is increased, so then the adaptive behavior can be maintained, as old age there is a greater probability of unpleasant events related to physical health, well-being and the life of loved ones.

The notion of resilience was created by the exact sciences, especially physics and engineering, which defined it as the maximum deformation energy that a material is capable of storing without undergoing permanent changes. When it was adapted to the human and medical sciences, the complexities related to the emotional aspects of the human being were considered [9]. Thus, with respect to the human being, resilience does not mean a return to an earlier state, but overcoming or adapting to a difficulty considered as risk [10].

The focus of resilience arises from efforts to understand the causes and evolution of psychopathology. These studies demonstrated that there was a group of children who did not develop psychological or social adjustment problems despite the researchers predictions [11, 12]. Pesce, Assis, Santos and Oliveira [8] agree that the definition of resilience converges to a sum of processes of social and psychic nature that allow healthy development even in non-healthy contexts.

Selligmann and Czikszentmihaly [13] studies explain how resilience can contribute to the quality of life construction. Infante [14] complements reporting that resilience reduces stress intensity and decreases negative emotional cues such as anger, depression, anxiety, while increasing curiosity and mental health. Therefore, the authors note that resilience has an effect not only to face adversity but also to maintain mental and emotional health.

Therefore, in the area of psychosocial intervention, resilience seeks to facilitate processes that involve the individual and his social environment, helping to overcome adversity, adapt to society and have a better quality of life [14]. In addition, even find ways to avoid and / or face the stress coming from the conflicts experienced at the time or throughout their life trajectory.

The idea of the cumulative effect of several risk events and their degree of adversity throughout life is defended by Pesce, Assis, Santos and Oliveira [8] as capable of generating negative development effects. This aspect is important to be considered in our study since the elderly population studied there is a great chance that the person will be exposed to this risk situation for a long time [15]. Rutter [16] further states that resilience is a result of the interaction between genetic and environmental factors, which is complex, since these aspects can act as both protection and risk factors.

It is known that the elderly, even under conditions of functional limitations and disabilities, can maintain a positive well-being sense. According to Neri [17], functional losses do not necessarily impede the continuity of emotional cognitive functioning. Like any human being, the elderly activates

compensatory mechanisms to deal with these losses.

Thus, in the process of aging, physical, psychological, and social role changes are challenges to the self and to the maintenance of human beings well-being. In this sense, old age can be characterized as a promising period for investigating factors and processes of resilience and vulnerability, and Couto [15] explains the importance of studying factors that promote resilience or vulnerability, because they can help to care and intervention with the elderly population with the aim of promoting successful aging.

In this sense, the present study aims to analyze the relationship between resilience strategies and the SOC model in elderly residents in the municipality of Ivoti / Brazil.

2. Method

The present study is characterized as a quantitative, descriptive and transversal design research. A total of 193 elderly people in the age range between 60 and 79 years old, of both sexes, living in the city of Ivoti / Brazil, participated. The sample was selected proportionally by age and sex of each in the health centers. All the elderly enrolled in their respective health centers were invited to participate. Inclusion criteria were over 60 years of age, living in the municipality of Ivoti, not institutionalized or hospitalized and possess mental and health conditions to have independence and autonomy to participate in the study. Signing the Free and Informed Consent Form. The exclusion criteria were: to present dementia processes, fragility syndrome, to be hospitalized or institutionalized. The instruments used for the study evaluated the variables of successful aging and resilience strategies.

The SOC Inventory (Selection, Optimization, Compensation) explains the concept of successful aging. Paul Baltes, Margret Baltes, Alexandra Freund and Frieder Lang developed it in 1999 [18]. The inventory used in this study is a reduced version of 12 items described by Freund and Baltes [5] as more favorable and evaluates the use of SOC strategies by the elderly. Each item consists of two statements: one describing the behavior reflecting the SOC model and the other offering a reasonable, but not SOC, option. The participant must decide which of the two alternatives characterizes his behavior. Almeida, Stobäus and Resende [19] validated this version for Brazilian culture.

Wagnild and Young [20] developed the Resilience Scale to measure resilience assessed by levels of positive psychosocial adaptation to major life events. This scale is composed of 25 likert-type items ranging from 1 (totally disagree) to 7 (totally agree). The scores vary from 25 to 175 and the high values indicate high resilience [8]. The scale is divided into two factors, the first being the Personal Competence composed of 17 items and the second is Self Acceptance and Life Acceptance composed of 8 items. This scale was adapted by Pesce, Assis, Santos and Oliveira [8] and considered relevant for Brazilian culture.

The Research Ethics Committee of the University approved the project with number 747.080 and the participants of this study were contacted at the health centers through the Municipal Council for the Rights of the Elderly and the Secretariat of Health and Social Assistance of the Municipality of Ivoti partnership. Participants signed a free and informed consent form, according to the norms of resolution No. 466 of December 12, 2012 of the National Health Council of the Ministry of Health that deals with research involving human beings.

3. Results and Discussion

Initially, has been performed the analysis of the variable resilience and its factors, personal competence and Self / Life Acceptance, followed by analysis of the SOC variable (selection, optimization and compensation).

Considering the descriptive analysis of the resilience variable, it was possible to identify that the participants presented resilient characteristics, since the average score of the analyzed population was 142.85 (dp.13.80), considered high, since the scale varied from 24 to 168 , As can be seen in the histogram below.

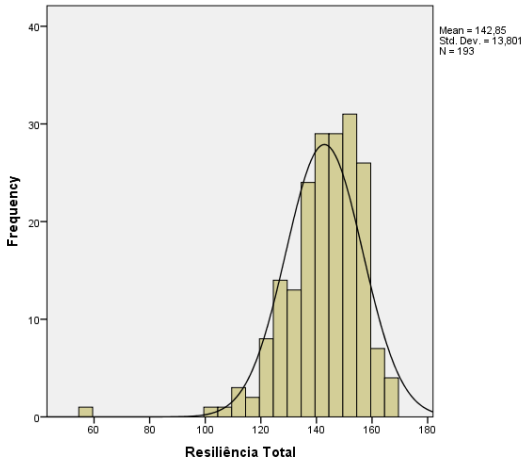

Figure 1 – Histogram of the variable Resilience

The original version of the Resilience Scale, developed by Wagnild and Young, was applied to 810 elderly people and represented by two factors: Personal Competence, Self / Life Acceptance. In the present study, has been maintained this subdivision, precisely because the study population is the same population chosen by these authors. The first factor: Personal Competence expresses self-confidence, independence, determination, mastery and perseverance. The second factor: Self / Life Acceptance expresses adaptability, balance, flexibility and a stable life perspective [20].

Considering the analysis of Personal Competence, the age group considered the most resilient was 75 to 79 years old, with an index of 106.58. In relation to the Self / Life Acceptance, the 65 to 69 age group had the highest score with an index of 41.81. Still observing the Personal Competence and Self / Life Acceptance proposed by Wagnild and Young [20], it is noticed that the first scored from 42 to 119 with a mean of 101.4, while the second scored from 15 to 49 , with a mean of 41.81. The average resilience indexes were 5.95 for Self / Life Acceptance and 5.98 for Personal Competence, which shows a small variation between these two factors, although not significant. These results are similar to those found by Couto [15] of 104 for Personal Competence and 41 for Self / Life Acceptance.

Table 1. Descriptive analysis of the factors of the variable Resilience

	N	Minimum	Maximum	Mean	Std Deviation
Resilience	193	57	168	142,85	13,801
Personal Competence	193	42	119	101,04	10,351
Self/Life Acceptance	193	15	49	41,81	5,012

Looking at the items on the scale individually, the ones that scored the most were: "My life has meaning" (6,66), "I am a friend of myself" (6,61), "In an emergency, I am a person whom other people can trust "(6.57)," I can face difficult times because I have encountered difficulties "(6.48)," I have an interest in things "(6,48) that refer to self-esteem, self confidence, self-efficacy, and problem-solving ability characteristic elements of a resilient person.

In relation to the resilience classification (low, moderate, high), only one person had a low index (between 24 and 75), 17 obtained a moderate score (76 to 125) and 173 had a high index (between 126 and 168). In the range of 60-69 years there was no low score in relation to resilience and in the range of 70-79 years only one participant had a low score.

Table 2. Distribution of the variable Resilience according to the age group

		Age range				Total
		60 – 64 years	65 – 69 years	70 – 74 years	75 – 79 years	
Resilience Classification	Low	0	0	1	0	1
	Moderate	9	2	3	3	17
	High	66	52	30	27	175
Total		75	54	34	30	193

In this study, statistical analyzes comparison between groups were also performed through the Mann-Whitney test to verify if there was a significant difference between the participants means according to the variables: age group and gender. Considering the age group, no significant difference was found. Even though each band was subdivided into two groups (60-64 years, 65-69 years, 70-74 years and 75-79 years), no significant difference was found ($p < 0.05$). However, it can be seen that in relation to resilience the age group 65-69 obtained a higher average index (102,65).

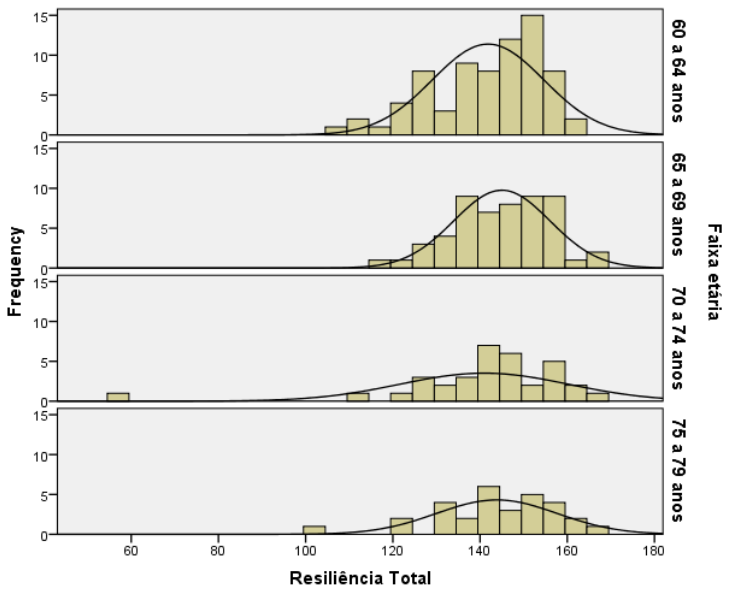

Figure 2. Comparative analysis of the variable Resilience in the age groups

Considering the analysis of Personal Competence, the most resilient age group was from 75 to 79 years old, with an index of 106.58. In relation to Self / Life Acceptance, the group from 65 to 69 age had the highest score (41.81).

Regarding sex, no significant difference was found since the men resilience rate was 95.50 and the women rate was 96.89. In Self / Life Acceptance factor men scored 99.90 and women 95.17. Observing the Personal Competence factor men scored 88.55 and women 99.61. Also regarding sex, it was evidenced that the sex with low resilience rating is a man. In addition, the age group shows that the person with low resilience is in the range of 70-74 years and that the largest number of resilient people is in the range of 60 to 64 years.

Performing a correlation analysis using Spearman's coefficient ($p \leq 0.05$), it was found that older people use more of the resilience strategy "doing things one day at a time" (rho = 0.188). However, they use less of the strategy "being on their own if they need it" (rho = -0,155).

Considering the variable strategy analysis for successful aging-SOC, in the case of the elderly evaluated in this study, the total mean obtained was 7.59, which may be considered adequate since the maximum score is 12 as can be Observed in the following histogram.

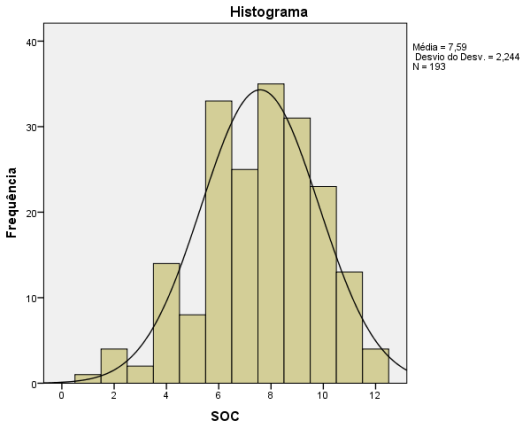

Figure 3 – Histogram of the SOC variable

In relation to the selection resource used by the elderly to achieve a successful aging, authors such as Freund and Baltes [4, 5] as well as Bajor and Baltes [6] distinguished selection based on losses and elective. In the study presented here, it can be observed that the selection based on losses obtained an average of 2.04 while the elective was 1.82. This fact may lead us to believe that loss selection was more commonly used by the elderly as a life strategy.

Considering the optimization and compensation items, the second averaged 1.89, while the first of 1.84. Thus, the strategy most used by the elderly participants of this study seems to be the selection by losses (2.04), followed by compensation (1.89), optimization (1.84) and finally by elective selection (1.82) that can be observed in figure 4.

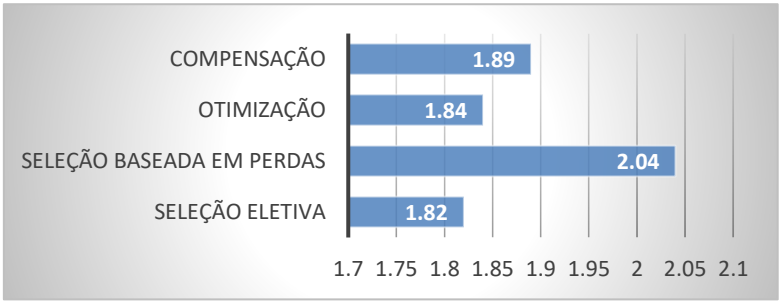

Figure 4. Distribution of the facets of the SOC variable

To investigate the relationship between the strategies use that lead to successful aging (SOC) and the resilience variable, the correlation analysis using the Spearman test at a significance level ≤ 0.05 was used. The results are presented in table 3 and show that the resilience has a positive relation (rho = 0.155; p = 0.032) with the SOC model. Thus, in this study it is assumed that being resilient may be a necessary factor for successful aging take place.

Table 3. Correlation of SOC and Resilience variables (N = 193)

Variable		*rho*	*p.*
SOC	Resilience	0,155	0,032
SOC	Resilience10 – I am determined	0,182	0,012
SOC	Resilience11 – I rarely think about the purpose of things	-0,199	0,006
SOC	Resilience17 – In an emergency, I am a person that people can trust	0,178	0,013
SOC	Resilience 20 – My life has meaning	0,179	0,013
SOC – Elective selection	Resilience	0,144	0,047
SOC – Elective selection	Resilience – Acceptance of self and life	0,154	0,033
SOC – Elective selection	Resilience10 – I am determined	0,167	0,021
SOC – Selection by losses	Resilience	0,144	0,047
SOC –Selection by losses	Resilience – Acceptance of self and life	0,154	0,033
SOC –Selection by losses	Resilience10 – I am determined	0,167	0,021
SOC – Selection by losses	Resilience11 – I rarely think about the purpose of things	-0,183	0,011

SOC – Selection by losses	Resilience17 – In an emergency, I am a person that people can trust	0,155	0,031
SOC – Selection by losses	Resilience 20 – My life has meaning	0,217	0,003
SOC – Optimization	Resilience 5 – I can be on my own if I need to.	0,153	0,034
SOC – Optimization	Resilience 17 – In an emergency, I am a person that people can trust	0,199	0,006
SOC – Optimization	Resilience 20 – My life has meaning	0,146	0,045
SOC – Compensation	Resilience 8 – I'm friends with myself	0,160	0,027
SOC – Compensation	Resilience 21- I do not insist on things that I can not do anything about	-0,159	0,028

It can be identified in table 3 that the strategies of the SOC model for facilitating a successful aging process is positively correlated with the resilient characteristics of being determined, being a person available when others need and realizing that their life has meaning. The SOC also has a negative correlation with rarely thinking about the objectives of the situations.

Elective selection, from the SOC model, is positively correlated with resilience, with the resilience facet of Self / Life Acceptance, and with the resilient characteristic to be determined.

The loss-based selection of the SOC model is positively correlated with the same variables of elective selection, but it also adds to the perception of the characteristics of being a reliable person, of life having meaning. Loss-based selection is negatively correlated with rarely having goals for their actions.

The optimization of the SOC model is positively correlated with resilient characteristics of autonomy, being a person in whom others place trust and again the perception of life making sense.

By contrast, from the SOC model, is positively correlated with the resilient characteristic of being friends with oneself and negatively correlated with the proposition of not insisting on things about which it can do nothing.

It believe to have found in this study an outcome similar to that evidenced by Lopes and Massinelli [(2013) who analyzed the level of resilience of caregivers of elderly people with Alzheimer's between 50 and 67 years old, identifying an average resilience of 147.2 points, considered high. In addition, Couto [15], when studying 111 elderly residents of Porto Alegre and Rio Grande, both cities in the State of Rio Grande do Sul/Brazil, found a total resilience of 144.9.

Still analyzing the fact that the elderly participants of this study were autonomous and independent, not being institutionalized can be explained to the high index of resilience evidenced. Walsh [22] also points out that elderly people who are kept in their homes with low doses of medicines do not show serious reductions in their competencies as institutionalized ones, which tend to be medicated and isolated from people and family environments.

In addition, it is observed that in all the age groups of the study, there is a predominance of the highest classification. It is interesting to note that, a research carried out in Sweden [23] showed higher resilience scores between the older part of the population than among the younger ones. Based on these assumptions, one may think that the ability to incorporate positive emotion into daily life may be the path

to resilience [24]. Valada [25] explains that the elderly population of his study is in a life phase marked by adversities, but, despite this, shows a capacity for adaptation to all the changes inherent to aging, being verified that they are multifactorial aspects and not the age condition for a satisfactory development.

Considering aspects of personal competence, one of the most punctuated items in this research, Hardy, Concato and Gill [26] explain that psychosocial and functional factors, such as well-being and autonomy, are important predictors of disability and illness, having more significant than clinical or demographic factors in relation to successful aging, associated with resilience. Strandberg and Pitkälä [27] in a Japanese centenarians study identified nine factors related to autonomy that can lead to resilience: preserved daily life activities, good social and cognitive status, regular exercise, wake up spontaneously in the morning, mastication preserved, not being a drinker, have no severe drop after age 95, frequent protein intake, live at home and be a man.

In addition, in relation to psychosocial factors, Baltes and Smith [3] affirm that SOC is a psychosocial construct and that study expression reaches its peak in adulthood, accentuating itself in aging as a plan of selection and compensation with personal and contextual characteristics Specific. Teixeira and Neri [28] complement by stating that the focus is the continuous search for an effective way of dealing with losses through psychological strategies. In our study, selection by losses was the strategy most chosen by the elderly residents of Ivoti, which seems to be adequate to the exposed by the authors mentioned above.

Melillo [29] reports that in relation to gender differences in conflict resolution, both present the same frequency of resilient behavior. Despite this, female people tend to rely on interpersonal skills and inner strength, while males tend to be more pragmatic. Valada [25] found that women, in a study carried out in Portugal, are more able to be involved and productive in social and family life that is because they have the possibility of establishing strong family ties, friendship and domestic productivity, generally inaccessible to older men for cultural reasons.

In relation to this study, with respect to gender and its relationship with resilience, Fortes, Portuguez and Argimon [10] and Cardoso [30] observed that women present a somewhat higher mean in the resilience scale, however, found a significant difference.

In a study by Jeste, Savla, Thompson, Vahia, Glorioso, Palmer and Depp [31], with a sample of people between 50 and 80 years (with the highest number of individuals over 80 years), it was identified that resilience is a predictive variable of successful aging.

Fontes [32] argues that successful aging models can offer a variety of mechanisms and strategies to increase the resilience of older people. However, these models have been criticized because associate the possibility of aging well with the availability of social and health resources. However, despite this, scholars in this field argue that there is a wide range of possibilities for developing the capacity to recover from adversity of life, since for the resilience to manifest it is necessary that there are situations of risk, aging can be considered one of them.

It is important to consider that being resilient is different from having an aging marked by the absence of illnesses, since elderly people even if they experience some form of disability can be considered resilient [33].

Therefore, from the data collected and analyzed in this study, it is identified that successful

resilience and aging are effectively interconnected, and the more resilient the person is in different areas of their daily lives, the more likely they are to have successful aging.

4. Conclusion

By the analyzed population it was concluded that they has a high index of resilience. No significant differences were found between the variables gender and different age groups regarding the resilience level. In the aging process, it is necessary that the resilience capacity of the elderly had increased, in order to be able to maintain the adaptive behavior, since in old age the probability of stressful events is greater. It is also considered that the aging process implies new demands that can be individual, family, government and society challenges in general and it is believed that the promotion of health depends on joint action between society, academia and the government. In this way, it is confirmed that social support (family, community, government) is important in the aging process, as it integrates the elderly into the community, minimizes the risks of social exclusion and favors the development and maintenance of resilience, which can lead to to successful aging.

In the national literature, there are few studies that seek to understand the strategies of selection, optimization and compensation for a successful aging; this research brings important data about the SOC strategies, which is expected to be the beginning of a larger understanding of these psychological strategies. It emphasize the importance of understanding these mechanisms in terms of intervention planning for the elderly in situations of vulnerability, since they are subjective and susceptible to increase. Therefore, it can be concluded that being resilient may be a necessary factor for successful aging.

5. Acknowledgement

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Modern cost management approach for development projects

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Abstract

Modern methods of cost management have already undergone considerable development since the early 1960s until today, but there is still the possibility of eliminating the weaknesses of these modern methods, mainly due to the emergence of a new trend in digitization. This is currently on the rise mainly in the automotive and electronics sector and will continue to expand over the next period. Currently and in the years to come, many other new positions and areas will have to be covered by Industry 4.0 as such, not only to improve productivity, flexibility, quality and speed in manufacturing area but within production as a whole. Research and development are areas that are key to increasing the added value of a product, so it is very important to pay maximum attention to them, mainly because of the cost reduction, but also the overall not only economic impact.

Keywords: Project Management; Cost Management; Planning; Productivity;

1. Introduction

In general, every business is a systematic activity operated by an entrepreneur for profit. For an optimal and steady profit-making process, businesses need to know their planned costs in the first place and allocate them in the most efficient way for optimal use. This brings us to the core of modeling the target costs as such, a process that should not be underestimated by businesses, primarily to achieve the highest possible profit.

Product modeling of product targets is defined by basic boundaries, which are, on the one hand, aspects of a technical nature, such as product specifications, and on the other hand, organizational aspects in which we must plan and manage all the processes and activities necessary to successfully meet the model costs.

2. Modern cost management methods

Modern methods for modeling product target costs today include two methods, which are able to use the costs effectively at their optimum level. These include:

1) **Target Costing (TC)**
2) **Life-Cycle Costing (LCC)**

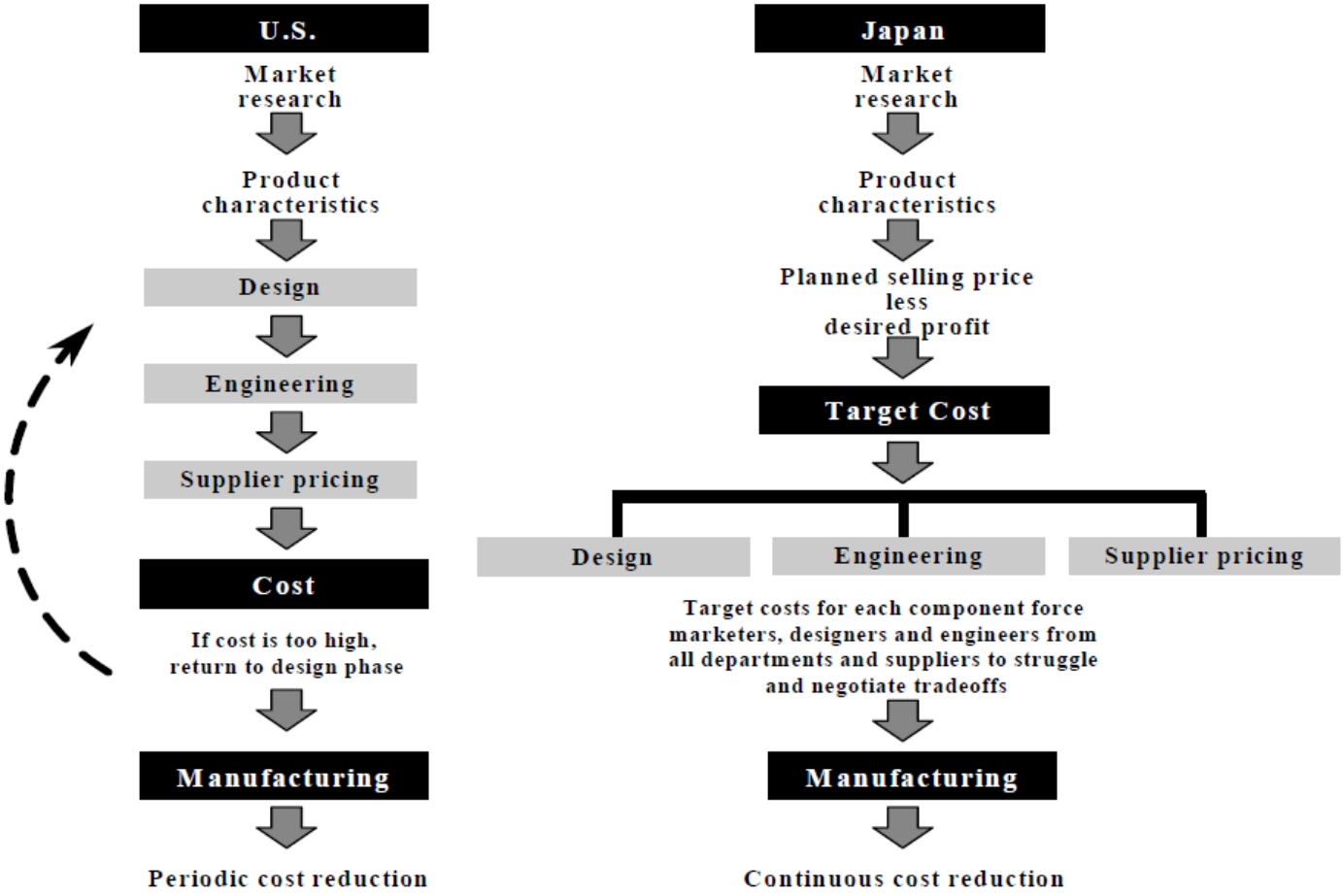

Figure 1. Comparison of Western and Japanese Cost Management Methods [1].

Figure 1 is comparasion model between Western and Japanese differencies of Cost Management Methods.

A full-fledged TC approach began in the post-World War II era when many resources were limited. During this period, Americans created the concept of maximizing required product attributes while minimizing product costs. This process has become known as "Value Engineering (VE)". Later the 1960s, VE was combined with the idea of influencing and reducing product costs at the earliest stages, such as during the product planning and development phases. The first use of VE in Japan, known as "Genka kikaku", occurred in Toyota in 1963. Later, the process became known in Japan as "Genka kikaku," which in translation is "Target Costing." [1]

3. Development project cost modeling

The modeling of target product costs is not only one of the priorities for today´s businesses, mainly because of the timely identification of the costs of the product and consequently for the fulfillment of these scheduled costs or the detection of possible deviations in the implementation of the cost plan. Each enterprise has its own know-how and its own internal procedures for scheduling product costs, yet none of the modeling methods for target product costs is currently capable of effectively planning and subsequently

allocating the cost of products at its early stages of development or design character. According to the available literature, such costs are allocated to products using a specific budget which is then drawn in the given period. According to the available information from practice, such costs are dealt with in a similar way, e.g. by creating a certain budget, which is only a prerequisite for the scope of the work or, in a better case, by creating a plan that should cover the extent of the necessary work to complete the development or construction.

Nevertheless, the experience or comparison of projects in planning such costing operations with real values is often erred. There are many reasons, for example, in which each project, the current procedures do not allow these changes to quantify, and therefore it precisely determines the possible deviations that a project may have, or the plan is created by a person who never managed such a type of project earlier. Another reason that significantly affects the cost is that each customer is subjective and as a result, the approach to the project solution or the specific outputs and procedures required to perform the work can vary greatly. I quote: "Strategic costs can reach up to 40% of target costs in some sectors (such as the automotive industry). An important constraint of TC is the fact that it´s working with future, estimated costs and expected production volumes" [2]. For these reasons, these phases require greater emphasis on planning and allocation of these costs. Strategic management accounting can now significantly affect the overall cost of products, by focusing on eliminating possible side effects of these methods (TC and LCC) already in the early stages of products. These methods of strategic cost management have had a noticeable development since the beginning of the 20th century. However, when the basic principles of these methods were applied in Bata's factories, the focus on pre-production stages did not show any noticeable development in the precise allocation of research and development costs even though enterprises in pre-production stages has greater possibilities to influence the overall future costs of these products. This trend is likely to be caused by the very difficult allocation of these costs to individual activities and processes [3].

For this reason, it is necessary to focus on these pre-production stages. In these development stages there are not only planned and proposed costs of production aspects but also strategy cost, which are not clearly planned or allocated. Still, these pre-production stages are seen as one of the phases of modern cost management methods where there is a reduction in production costs and costs for users, or the recycling and disposal of a product that is a part of these methods. However, it is necessary to consider this part as a separate, which should also save costs. Considering the constant pressure on these pre-production phases and the growth of Industry 4.0, the onset of digitization or constant globalization of the market, it is necessary to see these phases as a separate whole, in which it is possible to use some of the modern cost management methods we can also save a certain amount of costs. This approach will be key in the coming years for engineering companies that are linked to manufacturing companies and the overall manufacturing industry and the R & D sector.

Figure 2. Development of modern cost management methods [Own design].

Figure 2 is development process of modern cost management methods where are mentioned only important milestones.

4. Conclusion

According to connection of Industry 4.0 to engineering environment, it is necessary to stay productive, flexible and with appropriate quality. Also, according to globalization and competitive market, it is necessary to be fast, cheap and accurate enough for satisfaction and passion of our customer. This leads to a progressive way in planning and usage of some elements of modern cost methods such as TC and LCC. These methods can bring to engineering different view on whole environment and more of the above-mentioned elements such as cost saving, productivity, quality and even better relationship with customer. Modern cost management methods are very important to the current market. This is not only because of the set-up the required product before the start of the entire process of development, production, sales, operation till final disposal, but it mostly due to the accurate planning of the entire product, including plan of costs, its monitoring and implementation of this plan. Only in the case of a clearly defined product are we able to consider whether the product is able to reach all of its goals before starting the whole process.

5. Acknowledgement

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Intellectual Property Management in Small and Medium-Sized Enterprises: A Systematic Literature Review

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Abstract

Small and medium-sized enterprises (SMEs) have been prominent in the world economy, contributing significantly to the generation of jobs. Despite the relevance in the economy, SMEs underutilize the mechanisms of protection and appropriation of intellectual property. In order to gather and synthesize strategies, managerial models and good practices related to the intellectual property management in small and medium-sized enterprises (SMEs), this article aims to analyze systematically the literature, as well as to identify important aspects and gaps in existing empirical knowledge. For this, 53 articles from periodicals indexed in the scientific bases Web of Science, Scopus and Science Direct were analyzed. It was verified that there is a pattern of management actions in the scope of SMEs with regard to the protection, appropriation and intellectual property management.

Keywords: Intellectual property; IP management; Small and medium-sized enterprises; SMEs.

1. Introduction

The main resource of an organization in the current economic scenario is intellectual capital, made up of human capital (knowledge, skills and competencies of people) and intellectual assets (covering knowledge that has been encoded in some way). Within the scope of intellectual assets, there is a subset of knowledge resulting from an innovative process called intellectual property (patents, trademarks, trade secrets, etc.), which needs to be strategically managed in order to provide business competitiveness (Harrison and Sullivan, 2011; Agostini, Nosella and Soranzo, 2015).

The intellectual property management is a set of concepts, methods and processes that aligns the actions of protection and appropriation of intellectual assets with the business strategy (Harrison and Sullivan, 2011), involving the planning, organization and execution of related actions to innovative products and processes. It also includes the systematic monitoring of the rights of these protected assets, as well as their commercialization, through contractual agreements that may include technology transfer, licensing, joint ventures, etc. (Kitching and Blackburn, 1998; Tietze, Granstrand and Herstatt, 2006).

The ability of companies to achieve return on investment in intellectual asset development - appropriability - is a major concern of innovation and technology policies in several countries (Leiponen and Byma, 2009). For this reason, the most important goal of intellectual property management is to add value to organizations, maximizing profitability and thereby ensuring competitiveness in the market. In this context, managers make a series of strategic choices to capture investment returns on innovation, including, for example, which appropriation strategy to use and whether or not to patent (Holgersson, 2013).

Considering that the value capture of innovation actions is a key factor for competitiveness, the intellectual property management is fundamental for small and medium-sized enterprises (SMEs), given their characteristics, which include, among others, resource limitations and innovation process (Brooking, 2010; Agostini and Nosella, 2017). In addition, because they exist in greater quantity in the market (when compared with the number of large companies), the SMEs are responsible for the generation of significant number of jobs, configuring themselves as inducers of the economy of several countries, mechanisms that make them increasingly solid (Klapper, Love and Randall, 2015; Bijaoui, 2017).

Despite the growing importance of SMEs in national economies, research on intellectual property management is mainly focused on large firms (Holgersson, 2013; Thomä and Zimmermann, 2013; Brem, Nylund and Hitchen, 2017). In addition, several researches point out that SMEs underutilize the mechanisms of protection and appropriation of intellectual property due to two reasons: first, the high costs of protection and execution; and, secondly, the lack of awareness of the importance and functioning of the means of protection, especially the formal instruments. In this scenario, gathering the literature on how these companies manage IP is fundamental to systematize concepts, practices and methodologies that can be improved by the scientific community and applied in the corporate environment.

In view of the above, this article aims to gather and synthesize strategies, management models and performance indicators related to the intellectual property management within the framework of (SMEs), through a systematic literature review (SLR). To achieve the proposed objective, the paper is structured as follows: besides this introduction, which provides a brief elaboration of the concept of intellectual property management and its importance for SMEs; in section 2 the fundamentals and steps performed in the SLR are exposed; the results and discussions are found in section 3; and section 4 presents the final considerations.

2. Methodology

A systematic literature review aims to provide an overview of existing research on a given subject by identifying, selecting and analyzing relevant studies in order to allow for audit. It is an essential scientific activity, particularly suitable for the understanding of a specific phenomenon in which the literature is fragmented or presents mixed results (Kitchenham *et al.*, 2009; Vázquez-Carrasco and López-Pérez, 2013; Briner and Walshe, 2014). In order to efficiently and effectively organize and execute the processes of Systematic Literature Review (SLR), the present study was divided into three stages: (1) planning; (2) execution; (3) classification and synthesis of the results

2.1 Planning

The planning consists of the formulation of the guiding questions of the research and the definition of the procedures to be followed in conducting the SLR. These procedures were organized in a document called "SLR Protocol". The present review focuses on the following guiding questions: what are the management models, strategies and good practices of intellectual property management adopted in small and medium-sized enterprises (SMEs)? To the extent that these managerial models, strategies and best practices have been identified, can one discern a structure or pattern of managerial actions within these companies?

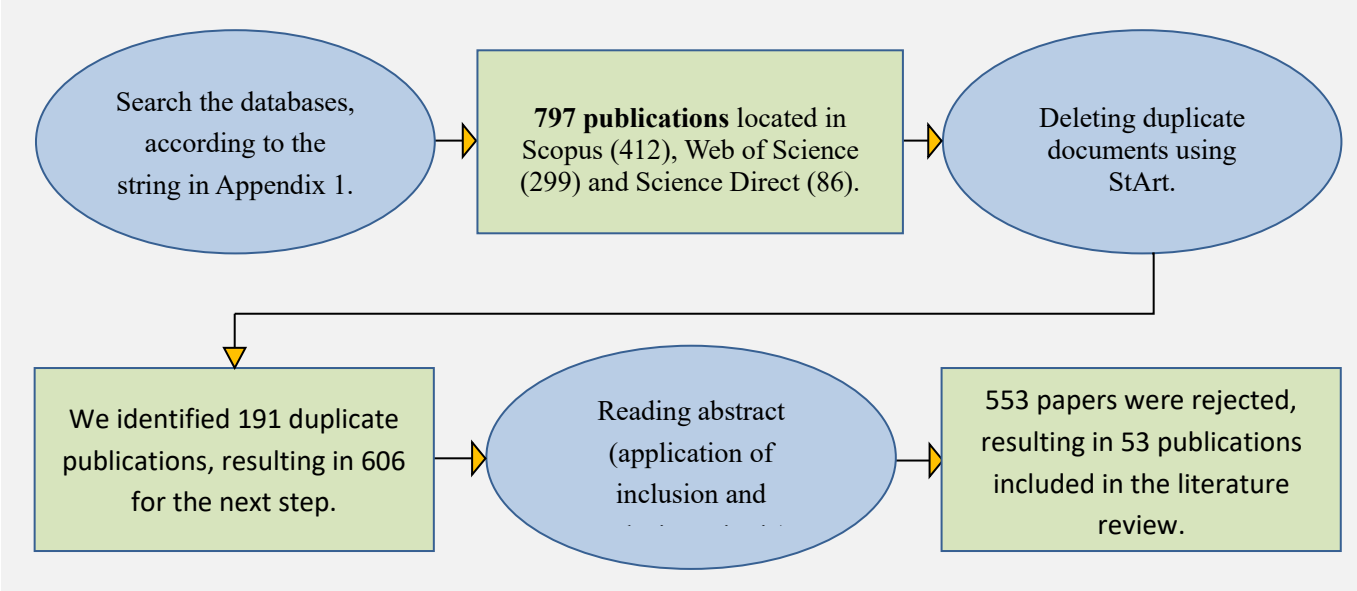
In order to find the answers to the questions presented above, three databases have been selected: *Scopus*, *Web of Science* and *Science Direct*. The choice of these bases is justified by the breadth, quality of indexed journals and their search functions. We opted for the inclusion of papers in the format of article, proceedings paper and review. Each database was queried according to the search string presented in Appendix 1, which included as many combinations as possible, in order to make the result more precise. The temporal cut of the search contemplated 32 years, from 1986 to 2018. The data obtained were treated by means of the software of *StArt* (State of the Art through Systematic Review), available in the portal http://lapes.dc.ufscar.br/.

It was adopted as inclusion criteria, in this systematic review, works that approach (1) management strategies; (2) management models; and, (3) practices related to intellectual property protection, appropriation and management actions in small and medium-sized enterprises (SMEs). On the other hand, besides duplicate works, those (1) that were not fully available in the researched sources were excluded; (2) that had a very specific approach (which could not be extended); and (3) those outside the scope of research.

2.2 Execution

Execution consists of the development of the research itself. The SLR was performed in the period from February 10th to July 31th, 2018, according to the procedures defined in section 2.1. Figure 1 illustrates the research process.

Figure 1. Research process in scientific databases



Source: Research results (2018), prepared by the authors.

As seen in Figure 1, in total, the first stage of the search process yielded 797 within the three databases. Duplicate documents were then deleted using StArt software and the inclusion and exclusion criteria were applied in order to reduce the list of publications. For this, a content analysis of titles and abstracts was performed to classify the main topic of each publication. When the content of the abstracts was inconsistent, the researchers looked more closely at the introduction, completion, or, if necessary, the full text. After this process, 553 results were excluded because they did not meet the criteria established in the protocol, resulting in 53 publications included in the systematic literature review.

2.3 Classification and synthesis of results

In this phase, a thorough examination of the documents selected in the previous phase was carried out. The following information from each of the 53 publications was tabulated: the title of the journal in which the work was published, the year of publication, the methodological procedures and the main results. Subsequently, from a codification, carried out with the aid of the *Nvivo Software*, the publications were classified.

Although the temporal cut of the revision covered publications from 1986 - year in which the first work contemplated by the string defined for the research was published - only since 1998 they have identified were published that were in line with the inclusion criteria defined for this SLR, as shown in Figure 2. According to the evidence, it is noted that the number of publications increased sharply, especially in the years of 2013 (nine articles) and 2017 (eight articles).

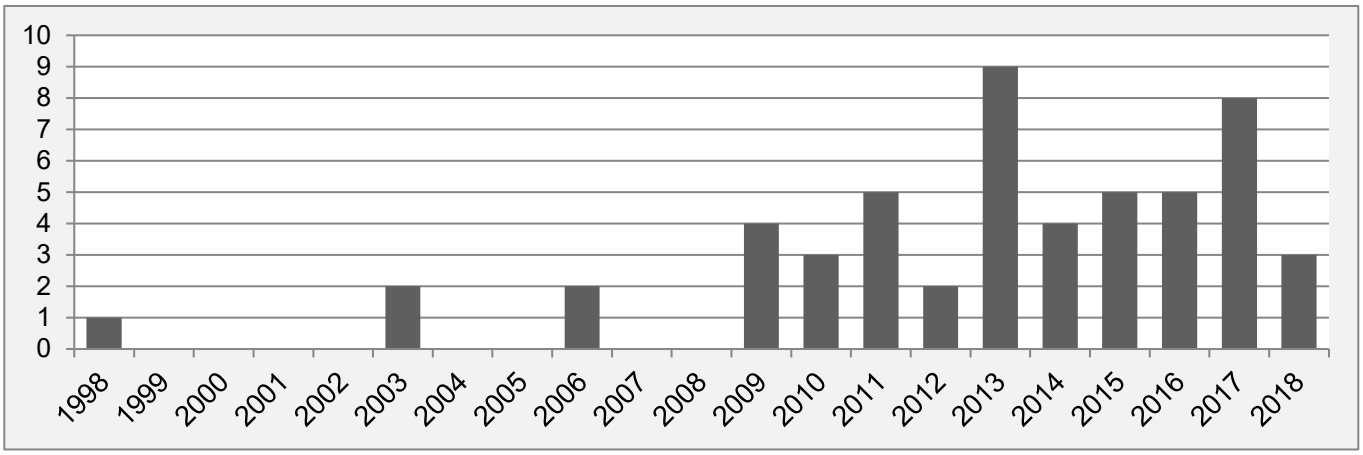


Figure 2. Number of articles published per year

Source: Research results (2018), prepared by the authors.

The results of this systematic review are mainly peer-reviewed articles (46), with the exception of seven proceedings paper. Peer-reviewed articles were most frequently published in the following scientific journals: Management Decision (four articles) and Technological Forecasting and Social Change (three articles). These numbers are not surprising, given the subject under analysis. The other articles (39) were published in a wide range of academic journals, whose scope is also related to business management, production engineering, technological innovation and economics.

With regard to the methodology applied in the development of articles, all studies are empirical studies, with the great majority having a quantitative approach (41). Only five articles, out of a total of 53, are qualitative and seven use quantitative and qualitative methods (Table 1). The method applied in the work with quantitative approach covers field research, panel data analysis, case studies (single or multiple) and semi-structured interviews.

Table 1: Methodology of the publications

Methodology	No. of publications
Empirical studies	53
Conceptual studies	0
Quantitative	41
Qualitative	5
Quantitative/Qualitative	7

Source: Research results (2018), prepared by the authors.

The codification of the revised documents allowed the identification of the main thematic groups. Thus, the work was grouped into three categories, according to the content scope of each one, as shown in Table 2.

Table 2: Thematic classification of the revised publications

Category	Number of publications	%
Intellectual property management and its implications in organizational strategy	21	39,6%
Strategy for protection and appropriation of innovation	20	37,7%
Cooperation strategy and management of intellectual property	12	22,6%
Total	**53**	-

Source: Research results (2018), prepared by the authors.

3. Discussion

This section presents the descriptive results of the study, involving the strategies, practices and propositions related to the intellectual property management in small and medium-sized enterprises (SMEs), according to the classification presented in Table 2.

3.1 Intellectual property management and its implications in organizational strategy

Intellectual property management must be integrated and aligned with the overall strategy of SMEs and adjusting as the business moves through different stages of its development desenvolvimento (Çela and Çela, 2013). This alignment improves the competitiveness of companies, by generating income and increasing market share. According to Brooking (2010), SMEs can accelerate their self-assessment by strategically growing their intangible assets, such as niche clients, brands and intellectual property, by comparing their actions with larger company strategies, describing and constructing scenarios for strategic planning which are easily understood by all employees and business stakeholders.

Based on a study of intellectual property in six German and Swedish companies, Tietze, Granstrand and Herstatt (2006) concluded that the process of defining a property strategy intellectual, aligned with the company's general strategy, should be divided into distinct stages, but did not define what these stages would be, only pointed out six aspects that should be considered to accurately describe these stages: capacity, competence, responsibilities, applied tools, awareness senior management and financial commitments. Eppinger and Vladova (2013), on the other hand, maintain that the steps that should integrate the process of managing the IP of an SME are the following: (1) assessment of the current market situation, technology, company and its environment of business; (2) definition of the desired IP situation to ensure a competitive position; (3) analysis of the options available to move to a more competitive market in terms of IP generation; and (4) decision on the allocation of resources for the implementation of strategies.

Internal knowledge is dominant in SMEs and focuses on the development of innovation activities (Valdez-Juárez, García-Pérez-de-Lema and Maldonado-Guzmán, 2018). For this reason, the intellectual property management in an integrated way to the organizational strategy is the main management challenge in many companies that, in addition to dealing with internally developed IP assets, should be concerned with the acquisition and exploitation of external technology, including an extensive set of tasks. However, Talvela et al. (2016) emphasize that, unlike large corporations, SMEs have limited knowledge about the

strategic IP management, and that to minimize this management deficit, four measures must be taken: (1) raising employee awareness of the invention process; (2) implementation of a compensation policy for employee inventions; (3) impairment of top management; and (4) understanding of the costs of PI protection.

In the view of Maldonado-Guzmán et al. (2016), the competitive market dynamics demand that SMEs incorporate knowledge management as part of their business strategies. For these authors, improving the flow of information sharing between the company and employees is essential in the construction and maintenance of competitive differentials, since it optimizes the production of knowledge that can be transformed into new processes, products and services, requiring integrated strategies of protection and ownership of these innovations. In this context, managers must make a number of strategic choices to capture returns on investment in the innovative process, including which strategy to use, whether or not to patent, among others (Holgersson, 2013).

The determinants of the implementation of ownership strategies depend on a number of factors. Holgersson (2013) interviewed managers of 26 entrepreneurial SMEs and found that the propensity for patents, for example, is lower in SMEs compared to large firms and that patenting as a means of ownership is of minor importance among SMEs. Patents were used by these companies to attract customers and venture capital, which is of paramount importance for competitiveness. Already Delerue and Lejeune (2011), when analyzing the determinants for the strategic use of business secrecy, from a sample of 297 SMEs operating in 19 countries, pointed out that attributes of the institutional environment, such as cultural values that shape organizational behaviors and managerial decisions, explain managerial use of this protection mechanism.

A study by Batra et al. (2015), together with 162 manufacturing SMEs in India, revealed that small and medium-sized manufacturing enterprises, because of their limited resource base, tend to be especially sensitive to the conditions of appropriability in their industry, and this influences the capacity for innovation companies. In addition, the results also highlight the technological orientation as a specific characteristic of the company that allows to overcome the adverse conditions of appropriability posed by the industry. Even when the patent regime is unfavorable, technology-oriented companies are able to innovate and perform better. Technology orientation includes a strong commitment to R & D, the use of improved technologies for decision making, the development of technologically advanced products, recognition of employees' efforts to acquire skills aligned with organizational strategies and adaptation to the environment in ever changing, in order to exploiting new opportunities (Batra *et al.*, 2015).

Small and medium-sized enterprises (SMEs) have difficulty identifying appropriate technological opportunities under severe constraints on capacity and resources (Lee *et al.*, 2014). For this reason, the intellectual property management has become crucial for these companies, which need to adopt different strategies to develop and exploit knowledge. In this context, several researches have been developed to provide SMEs with increasingly sophisticated IP management mechanisms. In Table 3, the main propositions of methodologies and strategies extracted from the documents that integrate the present systematic literature review are presented, divided into six thematic areas, according to the scope of the

research: (1) market intelligence; (2) financing capacity; (3) performance evaluation; (4) knowledge management; (5) support for decision making; and (6) operational efficiency.

Table 3 - Proposition of methodologies and strategies intellectual property management

Scope	Proposition	References
Marketing intelligence	Methodology for the identification of opportunities through the correspondence of multiple keywords, through the collection of relevant patents of the existing technology of an SME, using a patent citation process in two phases: (1) creation of a table of applications and technological attributes; (2) classification of patents collected in basic opportunities.	(Lee *et al.*, 2014)
	Logical Model of Strategic Patent Deployment Thinking (SPDT) to systematically collect and analyze market information in order to identify significant factors of consumer demand as well as current trends in the state and technology development, facilitating allocation assessments and solutions based on the technological resources of SMEs.	(Clarke and Turner, 2003)
	Methodology, based on the TRIZ theory, to support SMEs in the intellectual property management autonomously, through the monitoring of relative patents to the chosen technology, as well as analysis of the competencies and structure of the company to protect intellectual property through patents and trademarks.	(Regazzoni, Rizzi and Nani, 2011)
	Development of methodologies, aimed at identifying new business opportunities based on market demands, through design thinking and patent information as the basis for a set of operational processes.	(Fang-Pei Su *et al.*, 2015)
Financing capacity	A model for assessing the capacity of financing intellectual property for small and medium-sized technology enterprises, in order to assist them in the definition of strategies for raising funds from financial institutions.	(Shang, Qiu and Wen, 2017)
Performance evaluation	Methodology for the creation of the maturity curve, in order to show the evolution of SMEs in terms of performance in the management of intellectual property, based on two approaches: IIP - Innovation Index (A = Attention - knowledge; I = Interest - protection; D = Desire - management; A = Action - exploitation).	(Enjolras *et al.*, 2014)
	Diagnostic tool (intellectual property questionnaire), based on the adaptation of the AIDA model, to classify the practices and uses of IP on a progressive scale of four levels: (A = Attention - awareness about IP; I = Interest - IP protection; D = Desire - IP management; A = Action - IP exploration)	(Petit *et al.*, 2011)
Knowledge management	Framework for the analysis of knowledge management practices in the biotechnology sector, aiming to demonstrate that the knowledge-based view (KBV) should be modified and expanded to incorporate intellectual property, considering the sources competitive advantage as complementary and not mutually exclusive.	(Chen *et al.*, 2013)
	A method to aid decision-making on the most appropriate IP strategy for innovations in medical nutrition SMEs through a seven-step process of analysis, answers to the	(Weenen *et al.*, 2013)

Support for decision-making	following questions: (1) Is innovation radical? (2) Is it easy to enter competitors? (3) is reverse engineering? (4) is the cost of development and testing high? (5) what is the expected return on investment? (6) is a complicated platform technology; and (7) is it a single composition of matter?	
	Methodology to support decision making, which consists of dividing the portfolio of patents of SMEs into four quadrants: (1) patents with high market value but low value of the company; (2) patents with high market value and high value of the company; (3) patents with low market value and low value of the company; and (4) patents with low market value and high value of the company. For each of these quadrants, a set of generic strategies was assigned.	(Littmann-Hilmer and Kuckartz, 2009)
Operational Efficiency	Modeling the Activity table to increase the efficiency of the management of intellectual property at reduced costs by examining the actions of individual agents (resources or entities) in order to identify “bottlenecks" which hamper IP processes in the exploration phase.	(Modic and Damij, 2017)

Source: Research results (2018), prepared by the authors.

Analyzing the mechanisms of support to the intellectual property management presented in Table 3, it is observed that, although the focus of some propositions is for operational practices, there is convergence in the alignment between actions related to intellectual property for the organizational strategy of SMEs. Actions related to competitive intelligence, financing capacity, performance evaluation and knowledge management have a significant impact on the competitiveness of companies, as they provide the favorable conditions for the creation and delivery of value to customers.

3.2 Strategy for protection and appropriation of innovation

Small and medium-sized enterprises can apply various mechanisms to protect the results of their innovative effort as some methods complement or replace others. Different methods can be used in complementarity when inventions or technological innovations are composed of separately protectable components. In other words, protection mechanisms are not mutually exclusive (Landry, Amara and Saihi, 2009; Sey, Lowe and Poole, 2010; Hall and Sena, 2017). In the revised articles, the authors present two categories of protection methods: (1) formal protection mechanism (characterized by having a legal basis), which includes patents; industrial designs; trademark registration, copyright, etc.; and (2) mechanism of informal protection (extralegal), contemplating lead time advantage; trade secrecy, product quality maintenance, design complexity, etc. (Kelli *et al.*, 2010; Mol and Masurel, 2011; Thomä, 2013).

The choice of the method of protection and appropriation is conditioned by factors such as the degree and type of innovation, the organizational model and the general market environment. In other words, it depends on the context and organizational process, corporate objectives and technology characteristics of SMEs (Willoughby, 2013; Hall and Sena, 2017). For example, an expressive part of the operational knowledge in small companies tends to be tacit, functioning, therefore, as a method of effective

appropriation. In addition, patents may not be available to a large number of small enterprises, precisely because their tacit knowledge base can not be reduced to coded information (Thomä and Bizer, 2013).

The study by Leiponen and Byma (2009) other aspects, the relationship between firm size and the use of innovation protection mechanisms. According to these authors, the appropriation strategies adopted by SMEs differ in qualitative terms from the strategies applied in large companies. In research on Finnish SMEs in the manufacturing and services industries, it appears that many SMEs prefer informal protection practices to the detriment of formal protection mechanisms. Only small, R & D-intensive companies, in cooperation with universities and research centers, have seen patents as the most relevant protection instrument. The research also shows that cooperation actions related to innovation influence the type of appropriation strategies chosen by SMEs.

In general, SME managers do not notice, in formal protection mechanisms, a way to profit from innovation and do not have specific know-how in relation to these mechanisms (Agostini, Nosella and Soranzo, 2015). For this reason, they opt for informal methods, such as delivery time and business secrecy, to deem such methods more familiar, cheaper, less time-consuming, and more effective (Kitching and Blackburn, 1998; Leiponen and Byma, 2009). In a case study on the protection of innovations by SMEs, through analysis of patent data and 20 interviews with owners or managers, Mol and Masurel (2011) found that 65% of SMEs preferred other forms of protection to which patents and non-patented innovations are mainly protected by confidentiality clauses. The interviews also showed that the variables time in the market, type of innovation and R & D expenses influence the degree of formalization of protection.

A research about the available protection used by SMEs in their innovation activities, carried out through a multiple case study, pointed to evidence that complements the findings of Mol and Mol and Masurel (2011). According to the survey, SMEs tend to focus on protecting "innovative inputs" (which require trade secret protection and other complementary management practices) in contrast to protecting "innovative products" (which require patent protection) and therefore are believed to be more easily managed (Olander, Hurmelinna-Laukkanen and Mähönen, 2009).

From evidence gathered from research in manufacturing SMEs, Landry, Amara and Saihi (2009) point out that there is complementarity and independence between the various protection mechanisms (formal and informal), which are mutually reinforcing and should be considered as defining appropriation strategies. According to them, SMEs can formulate four generic strategies, based on complementary combinations, to protect their inventions and innovations: (1) pure formal strategy; (2) formal strategy supported by secrecy; (3) pure informal strategy; and (4) informal strategy supported by trademarks.

With respect to the protection strategies that can be applied throughout the innovative process, Seo et al. (2015) suggest four possibilities: formal (patents, industrial design), informal (secrecy, lead time), mixed (informal and informal) and investment in complementary assets. The authors analyzed the application of this combination of strategies in a sample of 640 manufacturing SMEs. The results show that the informal strategy (secrecy, lead time) is efficient at the stage of the invention. In addition, the mixed use of formal (patent) and informal strategies results in greater productivity at the marketing stage. Finally, the results suggest that productivity may vary depending on the investment in complementary assets.

Thomä and Zimmermann (2013), on the other hand, add the retention of qualified staff to the role of informal mechanisms of innovation protection. This appropriation strategy consists, in particular, of specific human resources management practices implemented by employers, with the objective to increase employee commitment. Such practices may include creating learning opportunities and appropriate compensation plans, valuing and recognizing employee contributions, and providing career opportunities. Considering that the SME knowledge base tends to be less explicit and less formal, resulting in know-how based on experience, with strong tacit elements typically embedded in human capital, retaining qualified staff should be a special concern of SMEs. Innovations developed on the basis of people's unique skills and quickly launched into the market generate greater profits for SMEs, since the knowledge created internally will be sufficiently secure through informal appropriation schemes (Agostini, Nosella and Soranzo, 2015; Seo *et al.*, 2016).

For Kitching and Blackburn (1998), there is a scale of application of methods of protection to intellectual property. In this way, SMEs can be divided into four groups, according to the degree of formalization of the methods used. In the first group, there are SMEs that do not take any conscious protective action; in the second, those that use informal mechanisms of protection (secrecy, advantages lead time, etc.); in the third, companies that adopt non-registrable legal regimes (clauses of confidentiality, licensing, etc.); and in the fourth group, SMEs making use of registrable intellectual property methods (patents, industrial design, etc.). According to the authors, owner-managers of SMEs preferred the formal mechanisms of protection in situations where the potential benefits of use were perceived as exceeding the operational costs of applying such mechanisms.

Regardless of the type of appropriation mechanism to be implemented (formal or informal), these should be in line with the company's overall strategy. In addition, it is important to consider that an overemphasis on protection (especially through patents or secrecy) rather than the exploitation of innovation may lead SMEs to face deterioration in their innovative and therefore economic and financial performance (Agostini, Nosella and Soranzo, 2015). In the present systematic literature review, four articles have been identified that address the importance of protection, but do not fail to emphasize that this protection must converge to the aspects related to exploitation.

In this sense, when dealing specifically with formal protection mechanisms, Flikkema, De Man and Castaldi (2014), through a study of a sample of 660 trademark applications in the Benelux countries, found that trademark counting is a an important indicator of innovation for SMEs. The study has shown that protecting IP is a reason for registration for about half of trademark applicants. In addition, about 60% of the new brands referred to innovation activities. Trademarks, besides providing protection to the image of the company and its products, are complementary mechanisms with regard to exploitation, because the stronger and more protected, the more value they add to the company and the products to which they are associated.

The importance of formal mechanisms for SMEs is advocated by Ghatak (2003), who points out that the effective use of patent information can be very useful in determining the competitive position of a company in the market. Corroborating with Ghatak (2003), the Kay, Youtie and Shapira (2014) research focused on how indicators of research and patenting activities can be applied in obtaining information from

technology-based IP strategies. For Wang, Hu and Cai (2012), based on data from 1378 patents of 639 small and medium enterprises in Zhejiang province, China, patenting is extremely relevant for SMEs, especially those that cooperate with universities and research centers. However, so that these companies can use and benefit fully from this appropriation mechanism, it is fundamental that the government creates a solid market environment for the industrialization of patented technologies, through specific public policies.

Finally, addressing patenting in firm-level SMEs, Hsueh and Chen (2015) developed, based on a study of 238 innovative SMEs, an taxonomy of patent strategies, through cluster analysis. The classification covers five categories of strategies: *comprehensive* (management of the most active patents, to evaluate the commercial value and its competitive use); *exploitative* (improving the quality of patents, by managing portfolio maintenance cost); *defensive* (deposit of significant number of patents, providing a shield to protect the company from litigation), *reactive* (filing and accumulation of patent advantage, without management and extraction of value, due to the absence of a suitable process); and *marginal* (use of patents as a complementary strategy to other protection mechanisms). The companies that fall into the category of comprehensive strategies are aligned with the position pointed out by Agostini, Nosella and Soranzo, (2015) about the focus, both in the protection and exploitation of innovation.

3.3 Cooperation strategy and management of intellectual property

Intellectual property management is taking a prominent position in the current competitive environment, in which companies, especially SMEs, are increasingly considering the application of open innovation strategies in order to offer new products, services and processes to the market. In the context of open innovation, companies - even those most prepared and aligned with the market - should consider the identification and application of knowledge as an essential factor in the innovative process (Agostini and Nosella, 2017; Brem, Nylund and Hitchen, 2017). Resource-constrained SMEs can adopt various forms of alliances, such as collaboration in R & D, outsourcing, joint venture, etc., including through collaboration in networks with larger companies and research centers (Hu and Tsai). These alliances provide access to human, technological and financial resources, ensuring appropriability through access to markets, partners and strategic knowledge, reducing the costs and risks of innovation (Hu and Tsai, 2006; Rehman, 2016).

According to Van Rijnsoever, Kempkes and Chappin (2017), SMEs, when participating in an innovation project, can apply three different strategies regarding the degree of openness: making, buying or allying. Based on a survey of 427 SMEs, these authors identified four latent categories of companies about the propensity to choose one of the three strategies cited above: (1) SMEs oriented abroad; (2) Inward-oriented PMEs; (3) Collaborating SMEs; and (4) Flexible SMEs. In the case of externally oriented and flexible SMEs, the evidence identified in the revised articles points to a positive impact on intellectual property (Agostini and Nosella, 2017; Brem, Nylund and Hitchen, 2017). In addition, these firms are more likely to interact with market-based agents (providers) in relation to localized learning networks; in both cases, there is an increase in innovation capacity (Zubielqui, Jones and Statsenko, 2016).

In analyzing primary and secondary data of 150 Italian SMEs, Agostini and Nosella (2017) found that the skills and knowledge of the employees (internal knowledge for innovation) have a positive impact

on patent propensity; and open innovation (partnerships and alliances) has a positive influence on the size of the patent portfolio. The study by Brem, Nylund and Hitchen (2017), carried out in the Spanish Community Innovation Survey database for 2,873 companies, pointed out that SMEs benefit from open innovation in different ways with formal and informal mechanisms of protection depending on which protection mechanism is used and how it is applied. However, according to the authors, the benefits for SMEs are much lower when compared to large companies.

In the view of Freel and Robson (2017), open innovation creates for SMEs a trade-off between the cost of losing control of the technology and the benefits of aggregating knowledge from other actors to improve innovation, since openness results in exposure, which can create tension with appropriation. In this sense, as a way to strengthen the trust of partners and promote the exchange of knowledge in the cooperation process, inventions resulting from collaboration in R & D can be presented in the form of co-patents (Lv, Zeng and Lan, 2018). Based on an analysis of 74 biopharmaceutical research and development alliances, Delerue (2018) has shown that joint patenting can be done to keep partners "hostages" as a way to ensure continuity of partnership, since this way of patenting creates overlapping boundaries that can persist beyond the alliance relationship, provided there is a managerial framework to monitor the process of joint patenting.

Finally, according to Belingheri and Leone (2017), among the main intellectual property management mechanisms for innovation collaborative, licensing is one of the most used in the scope of SMEs, being responsible for establishing an effective connection with the market in the innovation process. The authors assert that licensing is a strategic tool for companies, especially startups, as it provides them with additional channels to acquire know-how in the market. For Rassenfosse (2012), in SMEs one of the main determinants of patenting is obtaining revenue through licensing. Köhler (2011), in turn, complements addressing cross-licensing in his all. According to him, technological interdependence is a key factor in motivating companies to engage in cross-licensing transactions. In this type of licensing, there is a prominent use of patents as a means of blocking competitors and boosting their own technological image

4 Conclusion

This article has summarized empirical studies on the intellectual property management in small and medium-sized enterprises (SMEs). The review of 53 articles suggests some progress towards understanding, from the systematization of concepts, good practices, strategies and management models, how intellectual property is being implemented in SMEs. In addition, the study contributes to the literature outlining the research patterns in this area, since it allowed the authors to capture the entire spectrum of intellectual effort on the subject, through a rigorous approach in the analysis of the works.

Systematic review is an evolutionary process and aims to answer some important questions for research in a given area. Based on the content of this review, it was verified that there is a pattern of management actions in the scope of SMEs with regard to the protection, appropriation and intellectual property management. There was also a diversity of contexts, but the research focuses on three aspects: (1) the intellectual property management and its implications in the organizational strategy; (2) the relationship

between the formal and informal mechanisms of protection of the result of the innovative effort; and (3) the intellectual property management through cooperation strategies.

With regard to the methodologies and strategies proposals extracted from the reviewed documents, the contribution of the researches to market intelligence, monetization of intellectual assets, performance evaluation in IP management, knowledge management, decision making on appropriation strategies and operational efficiency. Most of the strategies and methodologies proposed had a focus on the creation and delivery of value by SMEs, since they converged towards the alignment between the actions related to intellectual property and organizational strategy.

Given the breadth and quality of the articles analyzed, this SLR is an important contribution from the academic point of view, since it will allow an analysis of which strategies to protect intellectual assets are best suited to SMEs, especially with regard to formal and informal mechanisms of appropriation and their relations with organizational strategy, in (partnership in R & D, outsourcing, joint venture, etc.), and can be improved by the scientific community and applied in the corporate environment.

In general, considering the characteristics of SMEs, future research should focus more specifically on certain mechanisms protection (trademarks, trade secrets, lead time, retention of qualified personnel, etc.), since a considerable number of articles dealt only with patents as a protection mechanism, while others only compared the formal and informal mechanisms.

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Apêndice 1 - Search strings applied in the systematic literature review

Databases	Search string
Scopus (Search date: February 15th, 2018)	TITLE-ABS-KEY (smes AND "Intellectual property") OR TITLE-ABS-KEY (smes AND patent*) OR TITLE-ABS-KEY (smes AND appropriability) OR TITLE-ABS-KEY (smes AND patenting) OR TITLE-ABS-KEY (smes AND trademark*) OR TITLE-ABS-KEY (smes AND appropriation) OR TITLE-ABS-KEY ("Small and medium-sized enterprises" AND "Intellectual property") OR TITLE-ABS-KEY ("Small and medium-sized enterprises" AND patent*) OR TITLE-ABS-KEY ("Small and medium-sized enterprises" AND appropriability) OR TITLE-ABS-KEY ("Small and medium-sized enterprises" AND patenting) OR TITLE-ABS-KEY ("Small and medium-sized enterprises" AND trademark*) OR TITLE-ABS-KEY ("Small and medium-sized enterprises" AND appropriation) OR TITLE-ABS-KEY ("Small and medium enterprises" AND "Intellectual property") OR TITLE-ABS-KEY ("Small and medium enterprises" AND patent*) OR TITLE-ABS-KEY ("Small and medium enterprises" AND appropriability) OR TITLE-ABS-KEY ("Small and medium enterprises" AND patenting) OR TITLE-ABS-KEY ("Small and medium enterprises" AND trademark*) OR TITLE-ABS-KEY ("Small and medium enterprises" AND appropriation).
Science Direct (Search date: February 20th, 2018)	
Web Of Science (Search date: February 25th, 2018)	TOPIC:(smes AND "Intellectual property") OR TOPIC:(smes AND patent*) OR TOPIC:(smes AND appropriability) OR TOPIC:(smes AND patenting) OR TOPIC:(smes AND trademark*) OR TOPIC:(smes AND appropriation) OR TOPIC:("Small and medium-sized enterprises" AND "Intellectual property") OR TOPIC:("Small and medium-sized enterprises" AND patent*) OR TOPIC:("Small and medium-sized enterprises" AND appropriability) OR TOPIC:("Small and medium-sized enterprises" AND patenting) OR TOPIC:("Small and medium-sized enterprises" AND trademark*) OR TOPIC:("Small and medium-sized enterprises" AND appropriation) OR TOPIC:("Small and medium enterprises" AND "Intellectual property") OR TOPIC:("Small and medium enterprises" AND patent*) OR TOPIC:("Small and medium enterprises" AND appropriability) OR TOPIC:("Small and medium enterprises" AND patenting) OR TOPIC:("Small and medium enterprises" AND trademark*) OR TOPIC:("Small and medium enterprises" AND appropriation).

IMPLEMENTATION OF HOLISTIC EDUCATION IN MUHAMMADIYAH ELEMENTARY SCHOOL INDONESIA

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Abstract

This research aims to describe the implementation of holistic education in Muhammadiyah Sleman Elementary School Yogyakarta. This research combined theoretical and empirical research. This was a qualitative research. The paradigm in this research was interpretive paradigm, while the research approach was phenomenology. Data collection techniques in this research were observation, in-depth interviews, and documentation. Data analysis was by interactive model of data collection, data reduction, data presentation, and conclusion or verification. The results of this research conclude that the implementation of holistic education in Muhammadiyah Sleman Elementary School has developed six human potentials, which are: cognitive, emotional, social, spiritual, creativity, and physical. These six aspects are developed harmoniously. All dimensions of children's development occur simultaneously and integrated, each does not stand alone, and also the development of one aspect is influenced by other aspects.

Keywords: Implementation, Holistic Education, Muhammadiyah Elementary School

Introduction

Islamic education is a series of processes of human empowerment towards *taklif* (maturity), whether intellectually, mentally, or morally, to carry out the humanism function which is assumed-as a servant (*'abd*) before their *Khaliq* (Creator) and as a "keeper" (*khalifah*) on universe (Mashudi, 2004). It means that the role of Islamic education is very important in human life; it cannot even be separated from the whole process of human life, because in education there is an effort to cultivate the human nature that can help human to achieve the integral of their human potential.

Islamic education aims to realize the growth of human personality in a balanced and comprehensive ways. Also develops human beings in all their aspects, whether spiritual, intellectual, imaginative, physical, either individually or in groups (Langgulung, 1986). Meanwhile, Daradjat (1992) stated that the goal of Islamic education is a change of attitude and behavior in accordance with the guidance of Islamic teachings, with the aims that people personality will deliver and load them into "*insan kamil* (the person who has reached perfection)".

This conceptualization of *insan kamil* is defined operatively by Mulkhan (1999) as the ability to think logically, honestly, discipline, have ethos and job skills, able to fill positions in society, both related to work and socially. It means that the objectives direction of Islamic education requires every human being to develop their human potential fully, in order to fill the role of religious and social as a product of education that has been achieved. In other words, in Islamic education there are complex multi paradigms that includes the dimensions of intellectual, cultural, transcendental, physical skills, and personality development. These concepts and dimensions are applied in an integrated way to achieve the goals of Islamic education (Zubaidi, 2001).

The realization of mental-moral and spiritual religious conditions becomes the development target of Islamic education system. Therefore, based on the moral ethical approach of Islamic education, it should be in the form of directing process of learners' life and religion development toward the ideals of Islamic life, while still paying attention and treating learners according to their own basic potential and socio-cultural background (Mulkhan, 1994).

The ideal goal of Islamic education brings its own problems at the operational level of Islamic education. Various criticisms appear related to the achievement of Islamic education objectives, for example by Azyumardi Azra that the problem faced by Islamic education is methodological crisis or pedagogic crisis. Nowadays the tendency among Islamic educational institutions is more focus to the teaching process rather than the learning process. The teaching process only fills the cognitive/intellectual aspect, but does not fill the aspect of personal and character formation. Education should be understood as an effort to improve intelligence, not just to fill the intellectual, but also the formation of personality and character (Azra, 1998).

Similar to Abdullah (1998) stated a criticism towads the methodology aspect of Islamic education that the teaching of religion, which relies in the form of static-indoctrinative-doctriner methodology, is not appealing to the students and at the same time does not lead the students to the stage of affection, let alone to the psychomotor stage. Suprayogo (Ghani and Riadi, 2012) put forward the same thing that the education process so far only prioritizes on cognitive aspects, and is less able to develop psychomotor and affective aspects. Education succeeds in leading young people to be smart, but not yet have characters as expected. Based on the opinion of Bloom (1979) there are three domains in learning, which are cognitive, affective, and psychomotor. All three domains must be developed comprehensively in learning.

More firmly stated by Mulkhan (2002) that all this time the schools, either public or private, Islamic or other, are more concerned with the ability of cognition, reasoning, and skills to answer exam questions. Teachers appear not patient enough in cultivating students' emotions and ability to understand others, at the same time the students fail to be understood by the teachers. While emotional development and education are limited to less relevant issues, they are also placed as part of the less important school program. Values, character, or affective education are not developed by schools.

It is realized that the learning process is still more dominantly oriented to aspects of knowledge which are hard skill, rather than other aspects, so that many teachers measure the level of learners' competence based on the grades of the exam test that are cognitive oriented. On the other hand, unconsciously, substantial violence and coercion of will are more often experienced by subjects learning in the classroom. In these classrooms the human subjects are often treated inhumanly and their aspirations are poorly heard, unless they follow the will of educators who unilaterally proclaim themselves as more mature and more *saleh* or *taqwa* (pious) (Mulkhan, 2002).

The above description of educational goals seems to lead only to cleverly cognitive children (who emphasize left-brain development, that only covering linguistic and logical-mathematical aspects), many lessons related to right-brain development (such as art, music, imagination, and character formation) get less attention. Even if there is, then the orientation is more to the cognitive, no appreciation that can foster excitement to learn and deepen the learning material further. Lessons which are in the form of subject matters also complicates the problem, because students do not see how they are related one another, and are irrelevant to real life. As a result, students do not understand the benefits of the learning material they have learned to the real life. This educational system makes people think partially, fragmented, or not in holistic (Jalaludin, 2012).

The reality of the educational process proves that holistic education in Indonesia is important to fight for its actualization, and should not just be a trend that appear and lost. This is supported by the research results of Widyastono (2012) which concluded that holistic education has not been implemented comprehensively in learning. Learning just develops the realm of knowledge, has not developed the realm of students' affective skills and affairs. Therefore it is very important for the application of holistic education in schools.

Holistic education is an education that develops all learners' potential harmoniously (integrated and balanced), including intellectual, emotional, physical, social, aesthetic, and spiritual (Miller, 2005: 2). These six aspects should be harmoniously developed. All dimensions of children's development occur simultaneously and integrated, each not stand alone and the development of one aspect is influenced by other aspects. Nava (2000) described a holistic education model that has multidimensional potential, including intellectual, social, emotional, physical, aesthetic, and spiritual, as illustrated in the following figure:

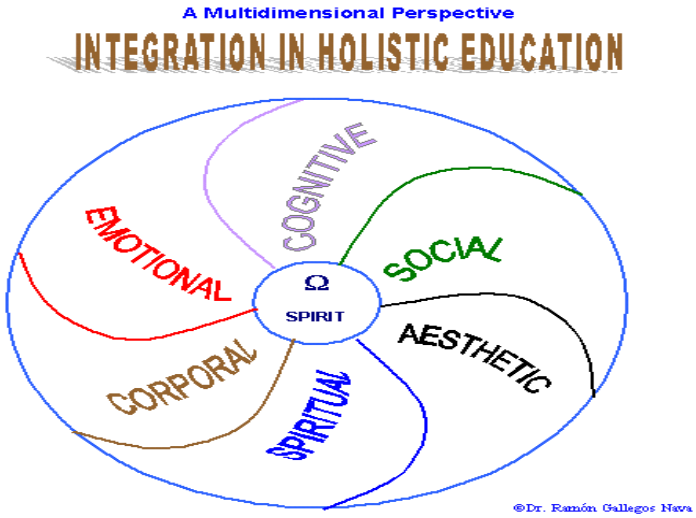

Figure 1. Multi-Dimensional Perspective Integration in Holistic Education (Nava, 2000)

Those multidimensional potential is in fact an integral whole that every individual has. Each of these potentials is interrelated or related, thus developing a potential to be associated with other potentials as well.

Megawangi et al (2011) more explicitly explained that human potential must be developed through education are: a) physical aspects: optimal development of fine and gross motor aspects, maintaining stamina and health; b) emotional aspects: concerning aspects of mental health; able to control stress, self-discipline of negative actions, confidence, risk-taking, and empathy; c) the social aspect: learning to enjoy their job, working in team, being sociable, caring about social issues and social-spirited, responsible, respecting others, understanding the differences and habits of others, obeying all applicable rules; d) the aspect of creativity: being able to express oneself in various productive activities (musical art, mind, etc.), as well as finding the right solution for various problems; e) spiritual apsect: able to interpret the meaning and purpose of life and be able to reflect about himself, knowing his mission in this life as an important part of a life system, and always be *ta'zim* (honour) to the whole creation of God; and f) academic aspect: logical thinking, speaking, and writing well. In addition, can address critical questions and draw conclusions from various known information.

Thus, the holistic education intended in this research is the educational model that builds the human being as whole and balanced by developing all the potentials, including the cognitive-intellectual, emotional, social, spiritual, creativity, and physical. The six potentials are a unity and should not be separated, because between one and the other are related.

Methodology

This research was conducted at Muhammadiyah Sleman Elementary School Yogyakarta, Indonesia. This research combined theoretical and empirical research. This research was qualitative research. The paradigm in this research was interpretive paradigm, looking at social reality as something holistic/intact, complex, dynamic, full of meaning, and the relationship of symptoms was interactive/reciprocal (Sugiyono, 2009). While the research approach was phenomenology, where researchers were involved in the situation and settings of the phenomena being researched. Data collection techniques were observation, in-depth interviews, and documentation. Data analysis was by interactive model of data collection, data reduction, data presentation, and conclusion or verification (Miles and Huberman, 1984).

Results and Discussion

Muhammadiyah education as part of the national education system, have the mandate of the constitution to produce holistic people through education at Muhammadiyah schools. Pudjo Sumedi (Ghani and Riadi 2012) asserted that Muhammadiyah educational institutions have developed rapidly, both in elementary and secondary levels, even universities spread all over the country. The style of schools or educational institutions of Muhammadiyah provides benefits for the people in Indonesia in terms of educating the life of the nation.

This is proven by the Muhammadiyah's work in the field of education in which the existence of Muhammadiyah education institutions. Up to 2010 Muhammadiyah has 4,623 kindergartens; 6,723 Early Childhood Education institutions; 15 Special Schools; 1,137 Elementary Schools; 1,079 *Madrasah Ibtidaiyah* (Islamic Elementary School); 347 Madarasah Diniyah (Islamic Center); 1,178 Junior High School; 507 *Madrasah Tsanawiyah* (Islamic Junior High School); 158 *Madrasah Aliyah* (Islamic High School); 589 High School; 396 Vocational High School; 7 Muallimin/Muallimat (Islamic Boarding Secondary School); 101 *Pondok Pesantren* (Islamic Boarding School); and 3 Vocational School of Pharmacy (Pimpinan Pusat Muhammadiyah, 2010).

One of the prominent features of Muhammadiyah educational institutions is educational institutions that present the values of renewal in education praxis in Indonesia, as characteristic of the parent organization, namely Persyarikatan Muhammadiyah. It is called bring renewal, because the educational institutions that was established by KH. Ahmad Dahlan had a different style with existing educational institutions or schools, in which he was adopted the form of Western model school and combining it with Islamic values. The combination of these two educational cultures was known as *"School met de Quran"*. The Dutch term was defined as a school with the values of al-Qur'an (Pimpinan Pusat Muhammadiyah, 2010).

Schools with the values of the Qur'an was a form of modernization of Muhammadiyah education to Dutch schools. One of the educational modernization agendas set out by Ahmad Dahlan from the start was the reform of the curriculum. This reform agenda was urged because at that time he saw the dualism of education. On one hand, Dutch schools teach only general sciences. This policy was seen to keep students from faith and piety. On the other hand, the traditional Islamic education which was represented by *pesantren* have been only teach religious knowledge and ignoreed general knowledge which was very

beneficial for the development of Muslim civilization. In such a context, Ahmad Dahlan seems realized how the duality of education will only give birth to a split personality generation. Students studying at a Dutch school would be a person who thinks only of worldly interests. Meanwhile, the generation of Muslims studying in *pesantren* would be only oriented toward the afterlife (Setiawan, 2015).

In the midst of such situation, Ahmad Dahlan believed that the dynamics of change was, has been, or will happen can be anticipated by teaching religion and general science in an integrated (holistic) way. This belief was then applied in the Muhammadiyah school. Therefore, the integration of religious and general knowledge in the curriculum was one of the characteristics of Muhammadiyah education. This modern curriculum later became a distinction between Muhammadiyah schools and other educational institutions. This characteristic was first established by Ahmad Dahlan when establishing a modern educational institution in Kauman on 1 December. Thus, since the beginning of this modern educational institution was established, it had a characteristic that the curriculum combines religious and general knowledges (Setiawan, 2015).

Therefore, in the formulation of Muhammadiyah educational philosophy, it stated that Muhammadiyah education is a modern Islamic education that holisticcally integrates religion and life, and between faith and progress. From the womb of Islamic education, give birth to a generation of educated Muslims who are strong in faith and personality, as well as able to face and answer the challenges of global era. This is Islamic education that is progressive (Pimpinan Pusat Muhammadiyah, 2010).

The above description is depicted that Muhammadiyah education emphasizes wholeness, both the educational system and practice, as well as the goals to be achieved by education. K.H. Ahmad Dahlan calls this wholeness education as an education that balances mental and physical development, between belief and intellect, between feeling and mind, and between the world and the afterlife (Hadikusumo, 1989).

This balanced education represents wholeness and integration, its focus is not only in one aspect. Arifin (1987) stated that the educational objectives of K.H. Ahmad Dahlan can be formulated into three key concepts, which are individual education, moral education or *akhlak*, and society education or social education. Formulation of educational objectives of K.H. Ahmad Dahlan shows the trident of educational objectives of individual, moral, and social development, that is similar to the concept of holistic education. It means that the trident of educational objectives is a holistic form of educational goals built by KH. Ahmad Dahlan.

Therefore since the beginning, before the existence of the National Education System, Muhammadiyah education has been oriented to the development of humanism potential that embraces holistic education mission, in which expected to be born from the Muhammadiyah education, students who are not only intelligent of intellectual side but can develop humanism potential such as emotional, physical, social, aesthetic, and spiritual so as to be more able to carry out the principles of religion in everyday life. This is

also reinforced by the results of 46th and 47th Muhammadiyah Congress that formally render holistic Muhammadiyah education as the vision of Muhammadiyah education program development.

Referring to the conceptualization of holistic education above, in fact since the founder of Muhammadiyah, KH Ahmad Dahlan, founded Muhammadiyah school has emphasized on the integrity, both on the educational system and practice, as well as the goals to be generated by education. Wirjosukarto (1962) stated that the formulation of educational objectives by KH. Ahmad Dahlan is to give birth to religious human being whose entire personal potential (individuality) can grow integrally (whole optimal), high moral, and have a positive social attitude manifested in the form of social action to promote the life and prosperity of society. This concept also confirms that in the Muhammadiyah education, the two sides of the basic needs of human life, material and spiritual needs, seek to be harmoniously developed (Kuntoro, 2006).

Zamroni (2014) said that the wholeness (holisticness) of education is meant to have a transformative nature, namely education that will lead people's lives to the better conditions, spiritual and material. Moreover, Zamroni clarified the educational system and practice established by K.H. Ahmad Dahlan, which is holistic and transformative, has characteristics of: 1) the integrity in purpose and learning materials, 2) the integrity of theory and practice, 3) the integrity between formal and non-formal education, and 4) the integrity among various educational centers.

Zamroni (Suyatno, 2010) observed from the socio-anthropological side by emphasizing on the profile of educational graduates idealized by Muhammadiyah education. Departing from this sociological observation, Zamroni named *Kyai* Dahlan education praxis as a transformative holistic education. It is called holistic education because the goal of Muhammadiyah education is to give birth to integral human being. This is in accordance with the popular short slogan at that time, such as: "*ulama* (Muslim scholar) intellect, intellect *ulama*". The process of education is a blend of theory and reality (practice), with a short slogan: "science of *amaliyah*, science of scientific ". Encourage and motivate learners to thoroughly master what is learned, with the motto: "reap what you sow".

Kyai Dahlan's educational thinking is called transformative education, because Muhammadiyah's educational goals not only provide provision that can be applied in various conditions, but also must be able to transform oneself and society. Thus Muhammadiyah's education encourages its students to not only master the knowledge and technology, but at the same time willing to internalize the knowledge one's learned into oneself, so that there is a process of self transformation, and willingness to share with the community.

Referring to the above explanation, the concept of transformative holistic education is intended to stating educational praxis that aims to give birth and educate learners into integral intact people who are characterized by the growth of all their potentials optimally. The optimization of self-potential is not to

give birth to a selfish individual who only takes care of his own affairs, but becomes a social-minded person willing to be involved in improving his society. With such understanding, Zamroni emphasizes Kyai Dahlan's education praxis on the wholeness of the graduate profile, which can be done when there is social interaction with the surrounding community.

K.H. Ahmad Dahlan calls this whole education as an education that balances mental and physical development, between belief and intellect, between feeling and mind, and between the world and the afterlife (Hadikusumo, 1980). Arifin (1987) said that the educational objectives of K.H. Ahmad Dahlan can be formulated into three key concepts which are individual education, moral education or *akhlak*, and society education or social education.

Formulation of educational objectives of K.H. Ahmad Dahlan shows the trident of educational objectives of individual, moral, and social development that is similar to the concept of holistic education. It means the trident of educational objectives is a holistic form of educational goals built by K.H. Ahmad Dahlan.

Kuntoro and Astuti (2012) briefly described the characteristics of the school and educational system of Muhammadiyah or the foundational thinking of education of K.H. Ahmad Dahlan as follows: 1) educational building based on religion, because religion can not be separated from life; 2) school education teaches religion and general science simultaneously; 3) an appreciation of intellectual intelligence as the asset of developing a dinamic life, renewing religious practice and thinking that impede progress; 4) religion is understood dynamically, not merely a ritual activity but being practiced to improve the life of the community, and 5) the purpose of education to build noble character committed in the effort to improve and promote social life.

The opinion of Kuntoro and Astuti showed that Muhammadiyah education orientation is on the development of intellectual intelligence, noble character, and social life. The three elements are a unity, integrated in the Muhammadiyah schools system. Therefore, it can be emphasized that Muhammadiyah education or foundational thinking of education of K.H. Ahmad Dahlan has since its inception been oriented towards the development of humanism potential (holistic education). Mulkhan (1997) mentioned and named the educational praxis of K.H. Ahmad Dahlan as a humanism education. This naming refers to the educational objectives outlined by K.H. Ahmad Dahlan. According to Abdul Munir Mulkhan's interpretation, the purpose of education by K.H. Ahmad Dahlan is the establishment of an independent social unit to save the world as the realization of Islamic teachings in the life of society and nation in the midst of the world association. Mulkhan also added, activities and education praxis of K.H. Ahmad Dahlan is addressed to design a new world, and a unity of humanity in the advancement of science and technology as well as civilization, blessed with the ethics of the Quran.

Implementation of holistic education in Muhammadiyah Sleman Elementary School has developed six human potentials, which are: *first*, cognitive potential. Theoretical constructs to develop cognitive-

intellectual potential are through: a) active learning, b) using student-centered approaches, c) learning by discussion and question-answer methods, d) teachers do setting class and class conductivity, e) intertwining educational interactions of three-way pattern in learning, f) building interpersonal communication of teachers and learners outside the classroom, and g) building psychological environment or social climate, intensive teachers and parents collaboration. The development of cognitive-intellectual potential is actually contained other potential development, because one aspect can be developed through other aspects.

Second, the emotional potential. Aspects of emotional potential are focused on: a) self-confidence, b) sympathy, c) empathy, d) stress controll, e) self-controll from negative actions, and f) respecting others. Train the students' self-confidence by asking learners to convey the results of discussions or assignments in front of the class. The form of self-confidence in learners is not only evidenced by the activities that exist in the class, but also the involvement in the contest both in school and outside school. In the aspect of sympathy, through learning, learners tell about the social problems that exist in the community in order to involving the emotions of learners. Learners study outside the classroom, in order to see first hand the learning material being taught. One of the ways is through outing activities, in order to add insight and provide real-life experience to learners.

In empathy indicators, school always encourage learners to help victims of natural disasters, and ask learners to help when there are other learners in distressed. School awareness is not only shown to the victims of natural disasters whose outside the school, but also the concern is shown to learners or school residents who experience distress. In the indicator of self-control of negative deeds, schools facilitate extracurricular activities and tutoring, thus after school hours learners can fill their spare time with positive activities. Indicator on respect for others is reflected in school routine activities such as welcoming the students' arrival in the school's gate and shaking hands, being able to appreciate and accept the opinions of others by habitualize the method of question-answer and discussion in the learning process.

Third, the development of social potential aspect focused on indicators of a) awareness of social issues and social-spirited, b) responsible, c) comply with all applicable regulations, and d) work in team. A social awareness attitude in school is developed through school culture such as visiting school's member who is in distress, collecting donations for victims of natural disasters, and visiting sick people. This applies not only to learners but to the entire school community.

The value of responsibility to the learner is reflected from picking up and disposing garbage to its place, the habit of disposing garbage to its place is not only contained the value of physical hygiene, but also the moral message of love hygiene. Another form of responsibility is to do the task given by the teacher. The pattern of giving homework is still strong in Muhammadiyah Sleman Elementary School. It is because not all learners have the same ability to capture or understand the lessons that have been delivered by the teacher in the classroom, so that learners need more opportunities to learn. The positive value of homework

is to train the personal responsibilities necessary to familiarize learning regularly, and also to build partnerships between schools and parents so that it empowers the education.

Developing aspects of social potential to comply with all applicable regulations, school have rules and regulations for teachers and employees as well as for learners. Even for students, the school have rules and discipline in the school and classroom. While the rules for teachers and employees are legally-formal has been set in the Decree of the Branch Board of Muhammadiyah Sleman. Developing the social aspects potential of work in teams is learners get used to working in groups in the learning process, and implementing cooperative learning. In addition, through Hizbul Wathan (Muhammadiyah Scout) activities and camp activities.

Developing aspects of social potential in building a sense of affection is reflected in the ability of teachers to speak well with learners in the learning process and also in daily life in the school environment. In addition, the value of brotherhood and peace is developed through school activities by organizing social activities. Social conscience is in the context of social relationship (interpersonal) or benefiting others. In addition, schools often hold friendly match with other schools or attend the contest outside the school as a medium to strengthen friendship relationships between learners and other school students, or strengthen the institutional cooperation between schools.

Fourth, spiritual potential. This aspect of spiritual potential is focused on indicators of: 1) devout in praying; 2) behave in gratitude; and 3) pray before and after activities. Devout in praying for elementary students of Muhammadiyah Sleman Elementary School is supported by the application of religious culture in school. The adherence to pray is cultivated in Muhammadiyah Sleman Elementary School through the school program, such as the habituation of *dhuha* and *zuhur* pray in congregation in school, and reading and memorizing of Quran for students and teachers, animal sacrifice of *qurban* in school and distribution of *zakat fitrah* (charity given to the poor).

The attitude of accepting the assignment from the teacher with an open attitude is a form of learners' gratitude towards the school's work. Learners receive homework given by teachers openly and with pleasure. learners feel not discouraged by the grade obtained. The development of spiritual attitudes can also be manifested in the form of praying before and after learning. It is cultivated every day and done in all classes as a manifestation of spirituality within the learners in learning.

Fifth, the potential of creativity. The development of creativity potential is reflected in the ability of learners to express themselves in productive activities. Self-expression in productive activities is manifested in the ability of students to writing in order to fill the school's wall magazine. Potential creativity also reflected through intrakurikuler activities of potential creation and the students' work displayed in the classroom. Decorations and classroom wall decoration are displayed by students as a product of lessons of Art, Culture, and Skills or Art, Culture, and Practice.

Sixth, physical potential, including fine and gross motor. Gross motor development is done through learning activities by inviting light gymnastics (ice breaking) in learning, and through extracurricular activities such as futsal, swimming, Tapak Suci/martial arts. While the development of fine motor potential is done through the development of intrakurikuler activities (lessons of Art, Culture, and Skills or Art, Culture, and Practice) and the potential creation of learners.

Every learner actually has human potentials, which are cognitive, emotional, social, spiritual, creativity, and physical, its just that these potentials can develop better, through education. It is an educational process that can develop these potential to be more optimal. The holistic education process is seen as being able to develop these potentials because in the point of view of holistic education, these potentials are a unified entity that can be develop to build a balanced and strong childhood personality.

Conclusion

The Muhammadiyah School as part of the National Education System as well as Islamic Education has mandated to the implementation of holistic education. It means that all Muhammadiyah educational institutions carry out the mission of implementing holistic education, which is an education model that develops all aspects of the human potential of learners (cognitive, emotional, social, spiritual, creativity, and physical), thus it is expected to be born from the womb of Muhammadiyah education the holistic learners, not only smart on the cognitive side, but also can develop other humanism potential.

These six aspects are developed harmoniously, one of the potentials does not evolve far beyond the ability of other aspects, because it can make humans become not holistic. All dimensions of children development occur simultaneously and integrated, each not stand alone, and the development of one aspect is influenced by other aspects. The unity and integrity of the multilevel, when successfully developed harmoniously, will become an integral human.

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Strategy to Improve Quality of Higher Education Institution Based on AUN-QA Standard

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ABSTRACT

Purpose – *The objectives of this research are (1) to describe and analyze the gap between Universitas Negeri Semarang (UNNES) academic and management resource and ASEAN University Network Quality Assurance (AUN-QA) standard; (2) to describe and analyze the strategy of quality improvement of Universitas Negeri Semarang based on AUN-QA Criteria.*

Methodology – *This research is conducted with qualitative approach combine with statistical analysis. The respondent in this paper is management positions at UNNES. Data were collected by interview, observation, documents study and questionnaire. Data analysis was performed with interactive analysis model and descriptive statistical analysis.*

Findings *– The results revealed that the academic and management resources at Semarang State University are good and potential to become a world class university. Quality culture in the implementation of tridharma (education, research and community service) that developed at Semarang State University has been oriented to higher education continuous quality improvement. Therefore, several strategies for improving the quality of higher education that must be implemented in order to achieve AUN-QA certification are: (1) changing mindset and work culture towards international standard, (2) re-structuring of human resource management through education and training, (3) re-structuring of university governance system, (4) strengthening regional and international networking, and (5) strengthening internal controls mechanism.*

Significance *– These findings can contribute to universities that are preparing to become a world class university to develop a holistic quality assurance system by using the AUN-QA framework reference.*

Keywords: quality assurance, higher education, governance, resources, and AUN-QA.

INTRODUCTION

Current and trends of higher educations are changing drastically. The Core functions of higher educations as the community scholars, the places of attractions and pool wisdom, enhancing for quality and excellence in teaching, research, community service, promotion and preservation of cultural dimensions. Higher education is the institution of education which always be insisted to be able to improve education's quality

globally with an international reputation. Globalization is a challenge for UNNES to prepare its students to compete with another university from the international region. Some challenges will be faced to get this international reputation, such as getting quality human resources, international network and cooperation, and international publication.

Law number 12 year 2012 regarding higher education article 51 states that quality higher education should produce graduates which are able to actively develop their potentials and spreading useful knowledge and/or technology for the society, nation, and the whole country. For the sake of maintaining the quality of higher education, Indonesia's government holds quality control system of higher education to obtain the quality higher education, whether as internal quality assurance system and external quality assurance system. As with the rest of the world, education is seen as a key vehicle to increase the wealth of individuals and the economic wellbeing of society.

In the past decade, the term "world-class university" has become popular all over the world. International University is not simply for increasing the quality of learning activity and research. More importantly, a world-class university need a multi-dimensional strategy for developing the capacity to compete in the global higher education marketplace. University should integrate all its functions and activities in higher education; teaching and academic programs, research and publication, community service, staffing, students, facilities, infrastructure, and the academic environment. The paradox of a world-class university is a concept that very popular but the indicator is not very clear. Altbach (2003) has investigated this construct and said that a world-class university: "everyone wants one, no one knows what it is, and no one knows how to get one". The institutional repercussion and contextual significance of a world-class university are possibly mainly governed by a drive (some peoples would state as a pragmatic requirement) to compete in a global education marketplace through the acquisition, adaptation, and creation of advanced knowledge (Salmi, 2009). If we agree about that, the need to compete worldwide is now a prerequisite of global higher education institutions. Even Tierny and Sirat's research in 2015 concludes that as with the world-wide view, education is seen as the primary vehicle for increasing individual wealth and economic well-being

Levin, Jeong and Ou (2006) argue that the world-class university is most commonly conceptualized around 'widespread agreement of a world class reputation', whilst Salmi (2009) believes a world-class predicate is imply 'on the basis of international recognition'. Furthermore, Levin, Jeong and Ou (2006) state that a worlwide university conception only serves to raise the questions as to what constitutes world class reputation. That argument means that global reputation university and therefore world-class position come to be measured through dimensions that are 'visible' (Levin, Jeong & Ou, 2006). The last, according to the view of Levin, Jeong and Ou (2006), research activity, publications, citations, and major faculty awards become the most significant measures of a world-class university. The measurements to achieve a world-class universities recognition are more based on performance achievement (output). However, the learning process does not seem to be a visible indicator and difficult to be measured. Even that Levin, Jeong and Ou (2006) worrying there will be a potential danger of conceptualizing world-class on a purely 'visible' basis emerges; in short, that the educational processes and virtues of higher education institutions are not considered.

The World Declaration on Higher Education for the Twenty First Century: Vision and Action (October 1998), in Article 11, Qualitative evaluation defined quality in higher education as "a multi-dimensional concept, which should cover all of its functions and activities which include academic and teaching programs, research and scholarships, staffing, students, buildings, facilities, equipment, community services and the academic environment. Furthermore, The Regional Report of Asia-Pacific (UNESCO, 2003b) argue that quality assurance in higher education as "systematic management and assessment procedures to monitor performance of higher education institutions". Internal evaluations and external reviews, conducted openly by independent specialists, if possible with international expertise, are important to improve quality. "To develop, implement, maintain and improve the quality of higher education, an institution requires installing a quality assurance system.

As higher education institution which is visioned for becoming university of conservation with international reputation, Universitas Negeri Semarang (UNNES) has strong commitment to provide services and facilities for students to improve its quality in terms of academic or non-academic. One of the performance indicators of good quality management is the achievement of excellent accreditation for each program. In the arranged Strategic plans, UNNES plans target of improving the number of study programs with A accreditation from 30% programs in 10% annually. Beside improving the number of A-accredited program, another challenge is related to improve the performance of the program to achieve international accreditation. One of the initiation was in 2015, where it was planned to prepare international sertification of ASEAN University Network Quality Assurance (AUN-QA).

ASEAN University Network (AUN) is a network of universities at ASEAN level with the aim of strengthening networks of cooperation among several major universities in ASEAN by promoting cooperation and solidarity among students and academics in ASEAN, developing academic and professional resources, and disseminating information to fellow academic community. AUN-QA (AUN-Quality Assurance) established in 1998 aims to develop a quality assurance network as a way to achieve and maintain a high quality in higher education.

AUN-QA model will be adopted by UNNES as the path to reach regional-accredited programs. The steps are 1) Strategic (QA at institutional level): the development of university's vision and mission to its quality control, 2) Systemic (internal QA system): the development of its quality from policy to document, and 3) Tactical (QA at Programme level): the development of quality from its curriculum to graduates. Thus, this research will review the strategy and quality of higher education's quality based on the standard of AUN-QA by following the study programs development based on AUN-QA.

Overview of World Class University

Simmons (2003) provides a widely discussion of the principles that should be fullfill to if a university is to be consider as a world class institution. The first principle recommends to the universities to align their mission and vision to local and international society goals. The second, universities should pay attention on education quality supported academic accuracy mainly regards to peer observation and knowledge generation. The final principle prompt the institution should be looking forward, future facing and educate educational democracy, mostly through academic freedom and the fostering of free ideas.

Salmi (2009) expand opinion that the main results of world-class universities can be attributed to 'three complementary aspects at play in top universities in the world rangking', they are a high concentration of talent, abundant resources and good university governance. The model of a world-class university drawn from the Salmi idea (2009) includes more than three comprehensive factors, but is further divided into a small part of this meta-construction. To achieve a world-class university recognition, universities members should be aligned the dimensions proposed by Salmi through a dynamic collaboration.

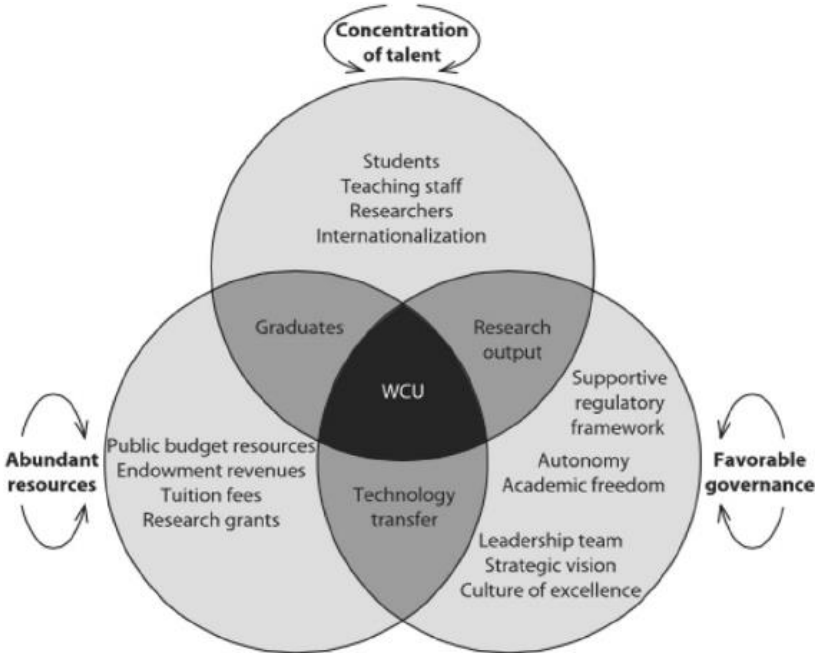

Figure 1: Characteristics of a World-Class University (Salmi, 2009)

Talent concentration can be measured as 'the best determinant of excellence' because the support needs of every world-class university has a critical mass of the best students and the best faculty members, as recommended by Salmi (2009). The third area of Salmi's model of the world-class university concerns about good university governance. Salmi (2009) trusts that the government has a responsibility to foster a higher education system. The government as the authority to set policy should ensure that world-class universities have a space to operate by allowing 'relative independence from the state' without being bound by externally imposed bureaucracies and standards. In addition to the degree of autonomy needed to enable the functioning of a world-class university effectively, Salmi (2009) also points out the need for further governance features to build and maintain world-class institutions. The more detailed explanation about this features, it is include inspiring and persistent leaders, strong strategic vision, 'philosophy of success and excellence' and 'culture of constant reflection, organizational learning, and change. Salmi, (2009) comprehensively illustrate the world-class university model and the relationship between the component in Figure 1.

Altbach (2003) seeks to provide a number of characteristics necessary for an institution to be recognized a world-class rank. Basically, Altbach (2003) suggests 'excellence in research' underlying world-class meaning in the context of higher education. Among other characteristics expressed by Altbach (2003), 'favorable working conditions' is one that is not clearly replicated by academics and other commentators.

Altbach (2003) argues that working conditions at world-class universities must be defined beyond remuneration but lead to a culture of academic understanding where academic freedom and 'atmosphere of intellectual excitement' are nurtured.

Furthermore, Altbach (2003) said that 'not many world-class universities'. However, this should not prevent universities from all mission groups who want world-class excellence. Indeed, it can be argued that fundamentally the idea of a world-class university should be conceptualized as an aspirational vision that underlies strategic decision making and ambitious and progressive strategic planning in higher education institutions.

Marginson (2013) explains the term world-class universities should be regarded as the 'concept of aspiration'. A major component of a world-class university is global research that is able to ‘gives substance to the notion of the world class university’ as Marginson (2013) argues. The idea was further developed as a Global Research University concept includes ‘being nested locally and nationally, combined with position and recognition at global level’.

METHODOLOGY

This research used action research approach and fullfill the following principles:

1) Identifying the subject of the research as unit of identity.
2) Building strength and resources from study and targeted unit.
3) Facilitating collaborative cooperation in every research methodologies by involving programs and targeted unit.
4) Integrating the understanding and action for the sake of the unit and targeted study programs.
5) Promoting co-learning and empowerment process.
6) Involving cyclical and recurring activities.
7) Disseminating the results of the research to all involved parties.

The steps of society empowerment can with participative action research approach can be seen in Figure 2.

Figure 2. The scheme of participative action research approach

The object of this research was the involving parties in quality assurance section of UNNES from the level of institution, faculty, and the programs level. Meanwhile, the informant of this research were the head of the study program, the head of the faculty/institution and supporting unit, lecturer, program administrative staffs, and students.

The primary data from the respondents were collected from open questions given in written scripts which is read in direct interview. The secondary data was obtained from library research by reading, understanding, and quoting several information.

The technique of analyzing the data used to answer the questions of the research followed these steps: 1) Descriptive Method: systematic, factual, and addresses of qualitative elaboration method, and 2) Interpretation Method: understanding relevant resources of data to the theme of the research. Before the interpretation, there would be a reduction to the data and review of the data to get the conclusion.

RESULTS

Introduction to AUN-QA Models

The AUN-QA Network is a non-profit and non-governmental organizations that established as an ASEAN quality assurance network in higher education with responsibility for promoting quality assurance in higher education institutions, enhancing the quality of higher education, and collaborating with regional and international bodies for the benefit of the ASEAN community. The objective of the framework of AUN-QA Strategic Action Plan is to set the outline of strategic plan including the key activities, in order to further develop the AUN-QA system through the enhancement of QA assessment and capacity building among the AUN Member Universities and also extend to non-Member in ASEAN region; which could lead to the acquisition of regional and international recognitions.

ASEAN University Network recognizes the significance of quality in higher education, and the need to improve a holistic quality assurance system to increase academic standards and raise the education, research and community service among its member universities in ASEAN. In 1998, it proposed the AUN-QA Network which led to the development of AUN-QA models. From the time then the AUN has been promoting, developing, and implementing quality assurance practices based on the empirical approach where quality assurance applies are verified, evaluated, improved and shared.

AUN-QA pursues to create feasible internal quality assurance (IQA) systems within all members and also universities in ASEAN. The AUN-QA assessment firstly at the program study level and now have developed for the institutional level evaluations using more complex assessment criteria. The main focus of AUN-QA assessment is for the purpose of improving the effectiveness of the quality assurance system. AUN-QA has adopted the Plan - Do – Check - Action (PDCA) approach for improving QA practices, AUN-QA accreditation is more system and process–oriented. Student attainment of outcomes related to what students "know and can do" is not a main focus.

The AUN-QA model for an Internal Quality Assurance (IQA) system involves of the following areas:

1. internal quality assurance framework;
2. monitoring instruments;
3. evaluation instruments;
4. special QA-processes to safeguard specific activities;
5. specific QA-instruments; and
6. follow-up activities for making improvements

An IQA system is the totality of systems that integrate all elements of program/university elements, resources and information assigned to setting up, maintaining and improving the quality and standards of teaching and learning, research, publication and community service. It is a system where the QA mechanisms are working to maintain and increase the grade of quality in higher education institutions. Currently, the criteria in the AUN-QA assessment at the program level are the third version. The 3rd version of the AUN-QA model for study program level cover the following 11 criterias (see figure 3).

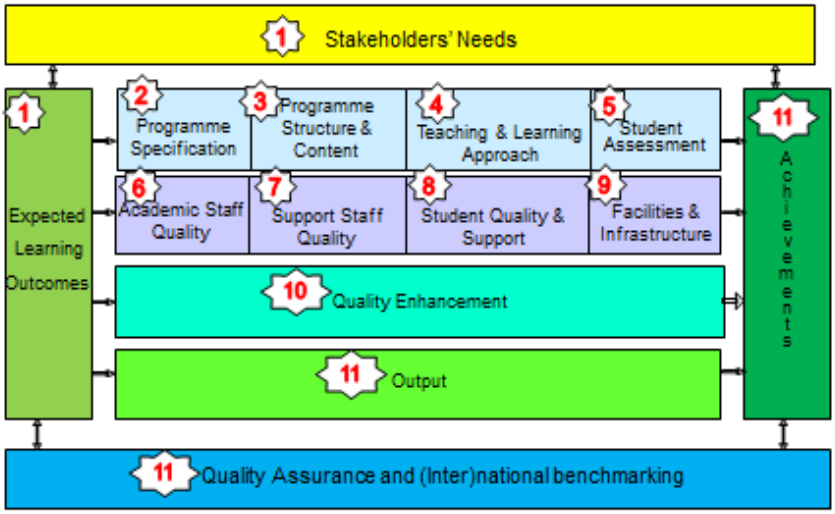

Figure 3. AUN-QA Model for Programme Level (3rd Version)

Outcomes–Based Education (OBE) Model

Outcomes are often discussed and acrimonious debated when a new educational program or a new curriculum is being developed. Generally early planning discussion will at some point focus on what students are expected to be able to do at after they graduate from the program of study: "What should our students be able to do?". Another question that usually arises is that students should possess when they graduate from the school or program: "What sort of people do we expect our graduates to be?" In both of these discussions the focus is on outcomes. Therefore it is very important for school/ universities to set their educational goals. Nearly all education institutions have goals that supposedly guide their work. The objective of their education will drive them to develope a curriculum.

Outcome-based education (OBE) is an educational approach that bases each elements of an educational system to reach goals (outcomes). After finished the educational experience, each student should have achieved the goal. It is an integrated system in theacing learning process, there is no single specified style of teaching or assessment in OBE; instead, classes, opportunities, and assessments should all help students reach the specified outcomes (Spady, 1994). OBE model differences from traditional education methods wich students are given grades and rankings and then compared to each other. The goal of traditional education style was to present the knowledge and skills to students and to provide students with an environment in which to learn.

Outcomes-based IQA has the potential to connect QA with student learning. Spady (1994) was developed a model of OBE that have four organizing principles identifies of OBE:

1. Clarity of focus: all teaching and learning activities should be systematically linked to the broad and specific outcomes identified for the education program and this should be clearly identified by the students and faculty members. These results can be achieved in different ways.
2. Designing back: The curriculum content should flow clearly from the most generale outcome to more specific outcomes and to each course. Assessment should be integrated with these outcomes coherently. In this way, the courses for students within and at the year level will have a clear relationship with the curriculum goals.
3. Teachers should give a high expectations for all students: This principle requires that successful and challenging classes and achievement of high standards be part of learning for all students. The focus of the assessment in the OBE model is the identification of the achievement of high standards of performance in relation to criteria established for achievement of outcomes.
4. Teachers should provide a broader options to allow students achieve the outcomes in various ways: Related to the principle number 3 is the view that different learners may take different ways, and different amounts of time or amount of effort to achieve the same outcome.

Academic and Management Resources in Universitas Negeri Semarang

Higher education in Indonesia has important roles in contributing to the development of the community and the supplier of quality human resources needed to maintain the economy, politics, and culture. The management of human resources is the part of academics civitas management. One of the challenges of human resources management is presenting professional lecturer which can produce expert graduates in their specific fields. The existence of professional lecturer will become the needs to realize the vision and mission of the university.

The result of the research showed that the academic and management resources in Universitas Negeri Semarang were in good and potential category to become world class university. It is shown by the strength and opportunity factors which were higher than the weaknesses and threats. The strengths of academic and management resources in Universitas Negeri Semarang were shown by these following stuffs:

1) The process of planning lecturers' need in short-term or long-term by changing, promoting, recalls, layoffs, and pension plans). These plans were done to guarantee the quality and quantity of lecturer which fills the criteria of good education, research, and services.
2) UNNES counts the ratio of staff:students as well as measure and monitor the burden of improving the quality of education, research, and services.
3) The recruitment and distribution of academic resources were based on academic freedom
4) The competence of academic staff was always identified and evaluated as well as improved by training and development programs.

Academic human resources become the challenge which should be developed by university in order to achieve higher reputation. It is in line to Arwildayanto (2010), stating that the existence of human resources in university becomes the challenges and necessity for this institution and stakeholders. The management of human resources in university should focus their job on handling the potentials of the lecturers and minimize their weaknesses. The human resources should be able to show professional lecturer profile under the principle of *Tri Dharma Perguruan Tinggi* (Three Fundamental Values of Higher Education) through education, research, and community services.

Quality of Culture in the Execution of *Tridharma* (Education, Research, and Community Services)

The attempts of improving the execution of education in Universitas Negeri Semarang were following these strategies.

1) Scoring the students constructively by the wished outcome
2) Scoring the students by considering the time, methods, regulation, distribution of weight, rubrics, and ranking in explicit and communicative way
3) The method of scoring included rubric and assigning scheme used to ensure the validity, reliability, and normality of the test to students
4) The scoring feedback should be done on time and helps the execution of the learning process
5) Students have the access to complain the applied scoring procedures
6) The method and criteria to choose students was determined and evaluated

7) There was a monitoring system to zoom out students' development, academic performance, and working loads
8) Physical, social, and psychological environment were conducive enough to develop students personally
9) UNNES gave awards and appreciation to motivate academic human resources based on the criteria in education, research, and services.

In doing research and community services, Universitas Negeri Semarang has done research collaboration to foreign university as the attempt of increasing international publication. It is in line to UNNES' vision as "University of Conservation with International Reputation". In the system of research management and community services, the performance and research activities were done by academic staffs were always be monitored and evaluated. It is due to control the quality of the stuffs along with its significance in spreading knowledge and fostering national development.

The facts above are the attempts of UNNES to do the *tridharma*, especially in improving the quality of its graduates. Like in Arcaro (1995), quality is a process, meaning that it is arranged to improve the output. The output is a product. In this case, the product of university is the service. Meanwhile, Lupiyoadi (2001) says that there are three orientation of quality which should be consistent; consumers' perception, products or services, and process. For the services, products, and process, it cannot be differentiated clearly since the product is the process. Kotler & Fox (1995) explains that there are six main dimension of quality services in higher education; they are: quality of instruction, academic advising, library resources, extracurricular activity, opportunities to talk with faculty members, job placement services.

Quality is a dynamic thing which constantly moves. If it moves forward, it is called improvement. If it moves backwards, it is called as decrease. Avianti (2005:10) says that quality can be seen as superiority or excellence as it exceeds the common standards. Something can be called as high quality if it fulfills the specific requirement needed by people. In other words, Sviokla (2002: 20) says that quality service is how the service of company is in line to consumers' wishes.

Quality or internal quality in Higher Education is arranged in Sistem Penjaminan Mutu Internal (SPMI-PT) perguruan tinggi or Internal Quality Control System of Higehr Education as the independent body from the university. Thus, the process of the control is planned, executed, and managed by the university itself.

The Strategy of Quality Improvement from Higher Education to Achieve AUN-QA Certification

The strategies of Universitas Negeri Semarang to achieve AUN-QA certification were: (1) changing the mindset and working culture based on international standards, (2) rearranging the management and human resources capacity by internationally standardized education and training, (3) rearranging the management of university, (4) strengthening the relation to regional and international based organization, and (5) strengthening the internal control.

Meanwhile, in the level of the programs, the improvement of education's quality was done by executing program's quality control in some strategies, including: (1) Understanding and analyzing the performance of the programs based on the strategic plan of UNNES or Higher Education Officials, (2) Obtaining models

of high quality management integration based on the criteria of AUN-QA, and (3) Arranging the guides of quality management based on the criteria of AUN-QA.

Individuals and international and regional level organizations have defined "world-class university". They have also created indicators to achieve world-level recognition. For a higher education, achieving a global reputation is very meaningful. But that is no more important than how to improve the higher education quality (input, process, output and outcome) continously by setting international standards, fullfill that standards and improving them sustainably. By continuing to maintain the quality of internal business processes of higher education will be drive to achieve international reputation.

CONCLUSION

The academic and management resources in Universitas Negeri Semarang were in good and potential category to become world-class university. It is shown by the strengths and opportunities factors of UNNES which were higher than the weaknesses and threats.

The strategies of Universitas Negeri Semarang to achieve AUN-QA certification were: (1) changing the mindset and working culture based on international standards, (2) rearranging the management and human resources capacity by internationally standardized education and training, (3) rearranging the management of university, (4) strengthening the relation to regional and international based organization, and (5) strengthening the internal control.

In conclusion, Universitas Negeri Semarang will be the world class university with the success factors of truly internationalization of the core mission of teaching & learning, research, academic services tolerance of cultural diversity, and managing quality continuously.

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Exploration of interactive classroom test method in universities based on the module thought

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Abstract

University is an important transit station for students to enter social life, undertaking the important mission of personnel training. Nowadays, a series of challenges exists in university education, such as the popularity of electronic information making students lack the ability to help each other. How to develop the mutual cooperation ability and active learning ability is an important topic in university education. This paper proposes an interactive classroom test method considering the learning characteristics of university students. The module thought is introduced to optimize the teaching system and help teachers to master classroom. In the interactive classroom test method, students can design the test paper based on the learning of course content and understanding. Then the different module group may use and review these test papers. The application and investigation of the proposed method are given by concrete practice. The results show that this method can enhance the spirit of teamwork and competition among students.

Key words: Active learning; Module thought; Test strategies; University education.

1. Introduction

With the improvement of economic level and comprehensive national strength, the demand for higher talents has increased significantly. In order to improve the national quality, university education is changing from elite education to universal education. However, the popularization of university education brings a series of problems. The main problem is the imbalance between the supply ability and the quality of education. [1] In detail, the teaching facilities and the number of teachers cannot meet the demand of students, resulting in a serious decline in teaching quality in universities. Meanwhile, more and more universities pursue the graduation rate of students blindly, ignoring the cultivation of students' morality and professional knowledge. [2][3]

To establish a healthy education system, we must improve the teaching methods. In the information age, the way for students to learn knowledge is increasing. However, it weakened students' teamwork skill, which led to the isolation of students. The task of higher education is to cultivate students' moral character, deepen the education and teaching, and realize the cultivation of high-quality talents. Therefore, it is

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necessary to adopt the scientific interactive teaching mode to improve the quality of classroom teaching and enhance the students' subjective initiative of learning and mutual assistance.

Classroom teaching in universities can be divided into two parts including classroom teaching and classroom test. [4] Specifically, classroom teaching mainly focuses on teachers' teaching ability and the driving ability of classroom atmosphere. The traditional classroom test is a test of teachers' teaching effectiveness and students' mastery of knowledge. Classroom teaching is a quick way to enhance students' professional knowledge and guide students' world outlook. In previous studies, educators and researchers have given many good suggestions and opinions on the teaching skills and methods of classroom teaching.[5][6][7]However, as an important part of testing the effect of students' professional knowledge learning, classroom test can directly reflect students' learning attitude and ability. Reasonable improvement of classroom test methods and increasing students' subjective participation can effectively enhance students' subjective initiative in learning.

The key problem to be solved in this paper is how to adopt a scientific student interaction model to enhance students' active learning ability, so that students can actively participate in classroom test, and then develop students' ability to ask and solve problems.

2. Interactive classroom test method

At present, although the rapid development of information technology has brought many conveniences to classroom teaching, it has also brought some problems. For example, some students are addicted to the Internet and neglect the training of professional knowledge and mutual help ability. Classroom test is an important measure to test students' knowledge learning progress and mastery level. [8] The traditional classroom test model is usually teacher-oriented, that is, teachers give test questions in stages according to the focus of the course content. However, this form of classroom test cannot make students actively accept the test. Students regard the test as a passive process. Therefore, this paper proposes the interactive classroom test method, focusing on improving the ability of active learning and mutual learning, based on the modular grouping idea.

2.1 Module grouping process

Module grouping mainly comes from computer systems. The idea is to divide the complex systems into controllable collections of units. The main advantage of modularized thinking in classroom teaching is the ability to divide large class students into controllable groups. It will simulate small class management to manage and teach. This method can improve the efficiency of teaching and simplify the management process. In educational practice, small class teaching is considered as a good teaching method, and the quality and effect of teaching have been widely recognized by educators.[9][10]Modularization can solve the problem that mass classroom teaching is difficult to manage and students' interaction is inert. It is helpful to develop students' unity, cooperation and innovative thinking. Module grouping is an important link in the development of interactive test method, which directly affects the teaching effect.

The module grouping method is determined by the contents of the syllabus and the number of students. Simple module grouping process is shown in Fig. 1. In Fig.1, M represents the number of groups, N

represents the total number of students, n represents the number of students in each group, k and i represent the integer part and remainder part of N/n respectively, and r represents the threshold value computed by Eq.(1).

$$r = [5(n + 2)/n]. \quad (1)$$

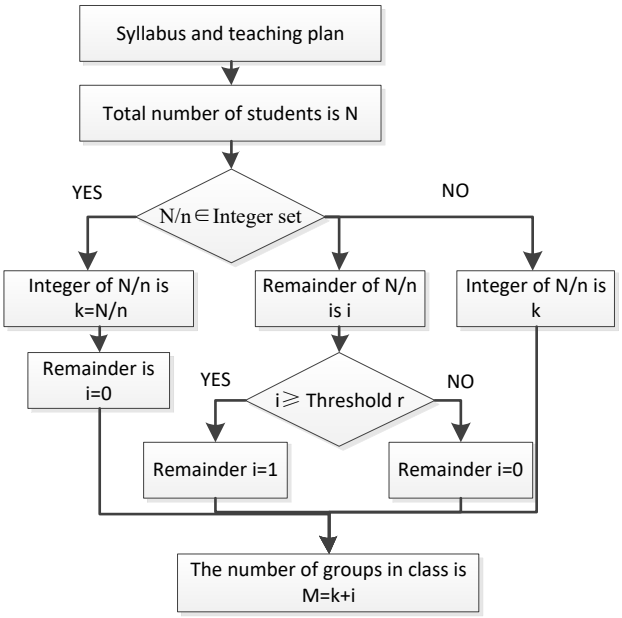

Fig. 1. Module grouping process framework.

2.2 Test methods and procedures

The core idea of interactive test method is to let students participate in the design process of test questions, so as to deepen the students' mastery of knowledge and mutual assistance among students. The method is divided into three stages, and the basic process architecture is shown in Fig. 2.

The first stage is to build a test bank. It mainly takes the module group as the unit. The students in the module group will determine the question bank of the module group according to the importance of classroom teaching knowledge and their own learning situation. Because there are some differences between the students' learning ability and their cognition of the key contents of the course, the test question banks given by each module group are not the same.

The second stage is the selection and correction of test papers. In order to improve the fairness of the examination, each group representatives randomly select the test paper and give the answers. Moreover, the examination papers submitted to each group are distributed to other module groups randomly. Each module group can review the examination papers based on their corresponding rules and methods.

The third stage is verification by teacher. The teachers mainly check the answers and scores of the examination papers. In addition, the excellent answer group and review group will be judged by teacher. This part of the award is added to the class performance score.

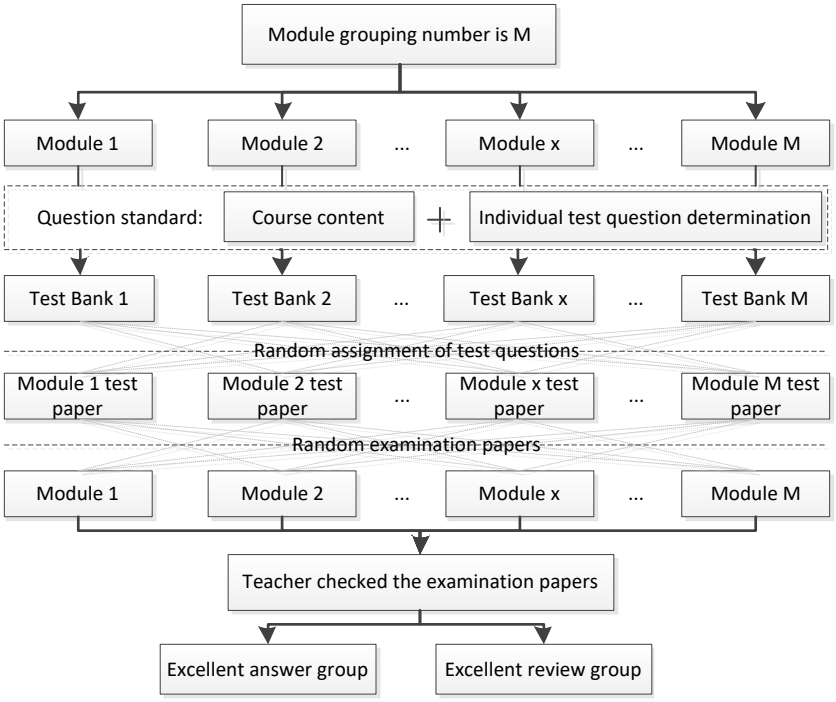

Fig. 2. Interactive test process.

The interactive test method is based on module group. This method mainly inspects the students' learning and group cooperation. It can let the students participate in the classroom test as the main body and enhance the students' subjective initiative in learning. This test mode proposed in this paper emphasizes the subjectivity and mutual assistance of students. Note that this test mode is based on the modular group. The cultivation of the sense of inter-team cooperation and the sense of inter-team competition is the focus of interactive test methods to cultivate students' world outlook. Therefore, interactive test methods can focus on the cultivation of students' world outlook, and at the same time, can improve students' active participation in learning.

3. Methods practice and results

Take the ***transportation planning and design*** course as an example, which is a compulsory course for students majoring in traffic engineering. We applied the interactive classroom test method proposed in this paper to the course and analyzed the results.

3.1 Practice design

The undergraduate student of grade three is majoring in this course. The number of students is 46. The specific information of the course is shown in Table 1. There are 32 school hours. In detail, the key content accounts are 20 school hours.

Table 1. Basic information of transportation planning and design Course.

Course name	Application level	School hours	Credit	Examination method	Major
Transportation planning and design	Undergraduate	32	2	Examination	Traffic engineering

As the content of the course is large, the curriculum test is divided into the midsemester and final exam. Due to the tedious work of finishing the final examination papers, the interactive classroom test method proposed in this paper is applied in the midsemester.

3.2 Application analysis

First, the teacher determines the number of module groups. Teaching experience shows that 5-8 people are controllable groups. Teacher chooses 8 people as the grouping unit for module grouping in this course. Therefore, according to the total number of students 46, the class is divided into six modules based on the module group partition process. Furthermore, A, B, C, D, E and F are used to numbered each group so that they can be easily distinguished. Each module group sets test questions according to the focus of teaching and the mastery of the knowledge learned by the group members, and submits them to the teacher. Through the analysis of the test questions submitted by each module group, the teacher supplements the key content further. Finally, according to the interactive test flow chart of Fig. 2, the interactive review of papers was carried out. Specific grouping information is shown in Table 2.

Table 2. Module group information.

Module name	Number of students	Name	Test number	Choosing test number	Review module number
Module 1	8	A	1	2	4
Module 2	8	B	2	5	3
Module 3	8	C	3	6	1
Module 4	8	D	4	3	5
Module 5	8	E	5	4	6
Module 6	6	F	6	1	2

In order to further verify the effectiveness of the method, the teacher sent out questionnaires for students to evaluate it. The evaluation titles are mainly concerned with the improvement of learning interest in curriculum content, mastery of curriculum knowledge, ability to summarize curriculum content, team cooperation and mutual assistance, and sense of competition among teams. The questionnaires were distributed to all the students who took part in the course. The students would give a comprehensive evaluation according to the quantified scores of each item. The comprehensive evaluation results are shown in Fig. 3.

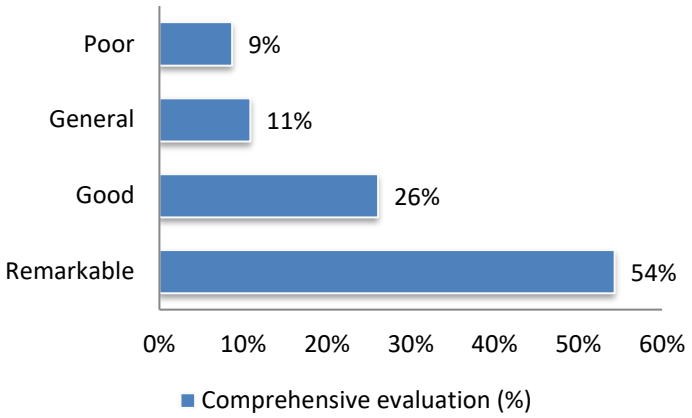

Fig. 3. Method implementation effect evaluation.

In Fig. 3, 54% of the students believed that the method presented in this paper could significantly improve the abilities in learning knowledge and teamwork. 26% of the students thought the test method was good. 11% of students think this method is effective and 9% of students think this method is not effective. In addition, the teacher gave a summary of the relevant opinions and suggestions from the students. The students' suggestions are as follows. The first suggestion is that the curriculum should increase opportunities for collaboration and internal collaboration among student teams, and that social practice activity should be added. The second suggestion is that teachers should be more involved in student interaction and increase mutual understanding with students.

From the above we can know that the interactive classroom test method proposed in this paper can effectively improve initiative learning ability, deepen students' knowledge mastery, improve cooperative work ability and enhance sense of team competition. However, to successfully apply this method to classroom teaching, teachers must meet the following two basic conditions. (1) Teacher should familiarize themselves with the contents of the course and fully grasp the curriculum knowledge system. (2) Teachers should take the students in the module group as the unit to carry out question-and-answer and homework design in the class stage, in order to increase the ability of students to work together.

4. Conclusion

This paper proposed an interactive classroom test method based on the module thought. The main purpose of this method is to improve students' initiative learning ability and mutual help and cooperation ability. This method considers the interaction between teachers and students, and divides a large number of students into module groups to realize the small class management mode. Compared with the small class teaching mode, the advantages of this mode are mainly reflected in increasing the competition and mutual aid mechanism between the module groups, which can make students realize the importance of team cooperation and cultivate competitive consciousness.

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